The Description and Use
OF THE
CARPENTERS-RULE:
Together with the Use of the
LINE of NUMBERS
Commonly called
GUNTERS-LINE.

Applyed to the Measuring of all *Superficies* and *Solids*, as *Board*, *Glass*, *Plaistering*, *Wainscoat*, *Tyling*, *Paving*, *Flooring*, &c. *Timber*, *Stone*, Square or Round, *Gauging* of Vessels, &c.

ALSO

Military Orders, Simple and Compound *Interest*, and Tables of *Reduction*, with the way of working by *Arithmatick*, in most of them.

Together with the Use

Of the *Glasiers* and Mr. *White's* Sliding-Rules. Rendred plain and easie for ordinary Capacities.

By *John Brown*.

London, Printed for *W. Fisher*, and *R. Mount*, at the *Postern* on *Tower-hill*, 1688.

Courteous Reader,

THis Little Book was first written by me several years since, and hath been accepted of among many, that ave had the Perusal thereof. And veral Impressions, in that time, beg sold off; and it being now out f Print, and none to be had, I have vised it, and left out what might ell be spared; and added that which ight make it more plain, and easier be remembred.

As for Instance, in the using of e Line of Numbers (commonly lled Gunters Line) for the measuring of Board, or Timber, or Stone, e fixed Points or Centers is only 10 d 12, for square Timber or Stone. And in measuring of round Timr or Stone (as round Timber) ere is used only 13.54 for Inches, d 1.128 for Foot-measure, being e Diameter in Inches, and Footeasure of any round solid, when one oot in length makes one solid Foot

of 12 Inches every way, or 1728 so
lid Cube Inches, which is a foot
Timber, or Stone.

And if the Circumference, or Gi
of the Piece about is given, then t
fixed Point or Center used, is at 4
54 the Inches, and 100 part of
Inch about, when one Foot, or 1
Inches long makes one Foot solid.

Or else at 3.545 the Feet, and 100
parts about, when one Foot long mak
one solid Foot equal to 1728 Cube I

Also, after every Problem, is t
brief way of working it by the Pen,
a proof of the truth of every Oper
tion by the Rule; being more th
was before in the former Impressio

Also, the Line of Pence is a
ded to the Line of Numbers, and
plain way set forth of the use there
by the Line on the Rule. Or the m
plain description thereof in a Pr
of Gunters Line 11 times repeate
which may be had with the Book,
Tower-Hill, or the Minories.

The Use of the Gunters Line

he Art of Gauging, *is here but brief-*
y hinted, because there are several
Books of Gauging, *purposely made*
for that Imployment, more compleat
than can be expected in this short Di-
scourse. And Lines of Area's *of*
Circles, in Ale-gallons, at any Dia-
meter given, from 1 *Inch to* 200 *In-*
ches; which may be used for round
or square Vessels, to give the content
of every Inch deep in any taper Vessel,
as fast as any one can write it down.

And Directions for the ready mea-
suring the Drip, or stooping Bottoms
of round or square Tuns, and the Li-
quor about the Crowns of Coppers.

Which Books are to be had at the
Postern *at* Tower-Hill, *or at the*
Authors, in the Minories.

To this Impression is added the Use
of the Lines called Diameter, Cir-
cumference, Square-Equal, *and*
Square *within a* Circle; *and to find*
the Circles, Area, *or* Content *by*
them; or, having the Area, *to find*
the Diameter, *or the* Circumference
or the Square-equal, *or* Square-
within.

Also, to this is added the way by the Pen, to multiply Feet, Inches and 12 parts of an Inch together whereby any Superficies, as Board, Floor, Wall, Yard, or Field, may be exactly measured by the Pen. Also by a second Operation, or Multiplication, may any Solid, as Timber, Stone, or round Vessel, be measured the Arithmetical *way whereof, worded as plain as in any Book whatsoever.*

Also the Use of the Glasier's Sliding-Rule, *to measure* Glass, *or any Superficies.*

And Mr. White's Sliding-Rule *to measure Timber; being as neat and ready a way as ever was used.*

Thus you have a brief Account of what is contained in this little Book, and I wish it may be helpful to many a Learner, for whom it is prepared. So I remain ready to serve you in this or the like.

John Brown.

From my House at the *Sphere* and *Sun-Dial* in the *Minories, London*

The

The Description and Use of the Carpenters Rule.

CHAP. I.

IT is call'd a *Carpenters Rule*, (rather then a *Joyners*, *Bricklayers*, *Masons*, *Glasiers*, or the like) I suppose, because they find the most absolute necessity of it in their way, for they have as much or more occasion to use it than most other Trades, though the same Rule may measure all kind of Superficies and Solids, which two Measures measure every visible substance which is to be measured. And it is usually made of Box or Holly, 24 Inches in length, and commonly an Inch and half, or an Inch and quarter in breadth; and of thickness at pleasure; and on the one side it is divided into 24 equal Inches, according to the Standard at *Guild Hall*, *London* and every one of those 24 Inches is

divided into eight parts, that i
Halfs, Quarters, and Half-quarter
or ten parts, as you pleaſe and th
Half-inches are known from th
Quarters, and Quarters from th
Half-quarters, by ſhort, longe
and longeſt ſtrokes, and at ever
whole inch is ſet figures, proceedi
from 1 to 24, from the right han
toward the left, and theſe part
and figures are on both edges o
one ſide of the Rule both way
numbred, to the intent that howſo
ever you hold the rule you have th
right end to meaſure from, provi
ded you have the right ſide.

On the other ſide you have th
Lines of Timber and Board mea
ſure, the Timber-meaſure is tha
which begins at 8 and a half, tha
is, when the figures of the Timbe
line ſtand upright to you, then I ſa
it begins at the left end at 8 and
and proceeds to 36 within an Inc
and $\frac{1}{8}$ of an Inch of the end. Alſo a
the beginning end of the Line o

Tim

Timber meaſure is a Table of figures, which contains the quantity of the under-meaſure from one Inch ſquare to 8 Inches ſquare, for the figure 9 comes upon the Rule, as you may ſee near to 8 in the Table.

On, or next the other edge, and ſame ſide you have the Line of Board-meaſure, and when thoſe figures ſtand upright, you have 6 at the left, or beginning end, and 36 at the other (or right end) juſt 4 Inches off the end unleſs it be divided up to a 100, then it is nigh an Inch and half off the end. This Line hath alſo his Table of Under-meaſure at the beginning end, and begins at 1 and goes to 6, and then the diviſions on the Rule do ſupply all the reſt to 100. Thus much for Deſcription: Now for Uſe.

The Inches are to meaſure the length or breadth of any Superficies or Solid given, and the manner of doing it were ſuperfluous to ſpeak of, or once to mention, being not

only easie, but even natural to every man, for holding the Rule in the left hand, and applying it to the board, or any thing to be measured, you have your desire: But now for the use of the other side, I shall shew it in two or three examples in each measure, that is, Superficial or Solid. And first in Superficial, or Board-measure.

Ex. 1. *The breadth of any Superficies (as Board, or Glass, or the like) being given, to find how much in length makes a Square Foot, (or is equal to 12 inches broad, and 12 Inches long; for so much is a true Foot Superficial.)*

To do this, look for the number of Inches your Superficies is broad in the Line of Board-measure, and keep your finger there, and right against it, on the Inches side, you have the number of Inches that goes to make up a Foot of Board or Glass, or any Superficies. Suppose I have a peice 8 Inches broad, How

many

many Inches make a Foot? I look for 8 on the Board-measure, and just against my finger (being set to 8) on the Inch side, I find 18, and so many Inches long, at that breadth, goes to make a Foot Superficial.

Again, suppose it had been 18 Inches broad, then I find 8 Inches in length, to make a Foot superficial; but if 36 Inches broad, then 4 Inches in length makes a Foot.

Or you may do it more easie thus: Take your Rule and hold it in your left hand, and apply it to the breadth of your Board or Glass, making the end that is next 36 even with one edge of the board or *glass*, & the other edge of the *board* shews how many Inches or Quarters of an Inch go to make a foot of the board or Glass. This is but the converse of the former, and needs no example, for laying the Rule to it, and looking on the Board-measure, you have your desire.

Or else, you may do thus in all narrow peices under 6 inches broad.

As ſuppoſe $3\frac{1}{4}$, double $3\frac{1}{4}$ it make $6\frac{1}{2}$, then I ſay, that twice the length from $6\frac{1}{2}$ to the end of the Rule, ſhall make a Foot Superficial, or ſo much in length makes a foot.

Ex.2. Having A Superficies of any length and breadth given, to find the Content, that is, how many Foot there is in it.

Having found the breadth, and how much makes one Foot, turn that over as many times as you can, for ſo many Foot is there in that Superficies: But if it be a great breadth, then you may turn it over two or three times, and then take that together, and ſo ſay 2,4,6,8, 10, *&c.* or 3, 6, 9, 12, 15, 18, 21, and till you come to the end of the Superficies. Note that the three ſhort ſtrokes between figure and figure, are the Quarters; as thus, 8 and a quarter, 8 and a half, 8 and three quarters, then 9, *&c.* till you come to 30, and then 30 and a half, 31, *&c.* to 36. And if it be divided

any

any further, it is to whole Inches only to 100.

The uſe of the Table at the beginning end of the Board-meaſure,

Firſt, you have five ranks of figures; the firſt, or uppermoſt is the number of Inches that any Superficies is broad, and the other 4 are Feet, and Inches, and parts of an Inch that goes to make up a Foot of Superficial meaſure: As for example, at 5 Inches broad you muſt have 2 Foot, 4 Inches, and 4 Fifths of an Inch more, that is, 4 parts of 5, the Inch being divided into 5 parts; but where you have but two figures beſide the uppermoſt, and Ciphers in the reſt, you muſt read it thus, At two Inches broad you muſt have ſix Foot in length, no Inches, no parts.

Thus much for the uſe of the line of Superficial or Board meaſure.

The Uſe of the Line of (Solid) or Timber-meaſure.

The uſe of this Line is much like

like the former: For first, you must learn how much your piece is square, and then look for the same number on the Line of Timber-measure, and the space from thence to the end of the Rule, is the true length, at that squareness, to make a Foot of Timber.

Ex. 1. I have a piece that is 9 Inches square, I look for 9 on the Line of Timber-measure, and there I say, the space from 9 to the end of the Rule, is the true length to make a Foot of Timber, and it is near 21 Inches, 3 eights of an Inch.

Again, suppose it were 24 Inches square, then I find 3 Inches in length makes a Foot, for so I find 3 Inches on the other side, just against 24: But if it were small Timber, as under 9 Inches square, then you must seek the square in the upper rank in the Table, and right under you have the Feet Inches, and parts that go to make a Foot square, as was in the Table of Board-mea-

sure

ſure. As ſuppoſe 7 Inches ſquare, then you muſt ſeek the ſquare Inches in the upper rank in the Table, and right under you have the Feet Inches, and parts that go to make a Foot ſquare, as was in the Table of Board-meaſure. As ſuppoſe 7 Inches ſquare, right under 7, I find in the Table 2 Foot 11 Inches, and 2 ſevenths of an Inch, divided into 7 parts, and at 8 Inches ſquare you find only 2 Foot, 3 Inches, 0 parts, and ſo for the reſt.

But if a *piece* be not juſt ſquare, but broader at one ſide than the other, then the uſual way is to add them both together, and to take half for the ſquare, but if they differ much, then this way will be very erroneous, and therefore I refer you to the following Rules: But if it be round Timber, then take a ſtring and girt it about, and the fourth part of this is uſually allow'd for the ſide of the ſquare, and then you deal with it as if it were juſt ſquare.

Thus

Thus much for the Use of th Carpenters Plain-rule.

I have also added a Table fo the Under-measure for Timber & Board, to Inches and Quarters; an the use is thus: Look on the lef side for the number of Inches an Quarters, your Timber is square or your Board is broad, and righ against it you have the Feet, Inches tenth part of an Inch, and tenth of tenth (or hundredth part of an In ch) that goeth to make a Foot o Timber or Board.

Ex. 3. A piece of Timber 3 In ches 1 quarter. *F. Inch.* 10. 100. square will have 13 7 5 9 parts to make a Foot. And a Board of 3 Inch and a quarter broad mus *F. Inc.* 10. 100. have 3 8 3 0 in length to make a Foot; and so of the rest, as is plain by the Table, and needs no further explication, being common to most Artificers.

A Table

A Table for the under Timber-measure, to Inches and quarters.						A Table for the under Board-measure, to Inches and quarters.					
in	qr.	feet.	in.	10p.	100		fe.	in.	10.	100
	1	2304	0	0	0		48	0	0	0
	2	576	0	0	0		24	0	0	0
	3	256	0	0	0		16	0	0	0
1	1	144	0	0	0	1	12	0	0	0
	1	92	1	9	7		9	7	2	0
	2	64	0	0	0		8	0	0	0
	3	47	0	2	4		6	10	2	9
2	2	36	0	0	0	2	6	0	0	0
	1	28	4	3	3		5	4	0	0
	2	23	0	4	1		4	9	6	0
	3	19	0	3	1		4	4	3	6
3	3	16	0	0	0	3	4	0	0	0
	1	13	7	5	9		3	8	3	0
	2	11	9	0	6		3	5	1	4
	3	10	1	8	8		3	2	4	0
4	4	9	0	0	0	4	3	0	0	0
	1	7	11	6	6		2	9	8	8
	2	7	1	3	3		2	8	0	0
	3	6	4	5	9		2	6	3	1
5	5	5	9	1	2	5	2	4	0	0
	1	5	2	6	9		2	3	4	2
	2	4	9	1	2		2	2	1	8
	3	4	4	2	6		2	1	0	4
6	6	4	0	0	0	6	2	0	0	0
	1	3	8	2	3		1	11	0	5
	2	3	4	9	0		1	10	1	5
	3	3	1	9	3		1	9	3	3
7	7	2	11	2	8	7	1	8	5	8
	1	2	8	8	6		1	7	8	6
	2	2	6	7	2		1	7	2	0
	3	2	4	7	7		1	6	5	8
8	8	2	3	0	0	8	1	6	0	0
8 1/4		2	1	3	9	8 1/4	1	5	4	5

Note also, that this Table, or any smaller part of under-measure, may be supplyed by the divisions of the board and timber-measure only as thus; Double the inches and parts of breadth for board-measure, or of squares for timber-measure, and seek it in the Lines of board or timber-measure, and count twice from thence to the rules end, for board, or 4 times for timber, and that shall be the true length that makes a foot of board or timber.

Ex. 4. At 4 inches and $\frac{1}{2}$ square or broad 4 $\frac{1}{2}$ doubled, is 9. then look for 9 on the board-measure, and two times from thence to the end, shall make a foot of board.

Or look for 9 on the Line of timber-measure, and 4 times from thence to the end of the Rule, shall be the true length to make a foot of timber, at 4 inches $\frac{1}{2}$ square.

But if it be so small a piece, that when it is doubled, the number is not

not on the divided part of the rule, then double it again, and count 4 times for board-measure, and 16 times for timber.

Ex. 5. At 2 inches and a half, a quarter broad, or square, that doubled, is $4\frac{1}{4}$, which is not on the rule, therefore I double it again, saying, $4\frac{1}{4}$ and $4\frac{1}{4}$ is $8\frac{1}{2}$ which, is on the rule; then for board, count 4 times from $8\frac{1}{2}$ on the board-measure, to the upper end by 36, to make a foot of board at $2\frac{1}{8}$ broad: And for timber, count 16 times from $8\frac{1}{2}$ near the beginning of timber-measure, which will be near 32 foot, to make a foot of timber at $2\frac{1}{2}$ square: But if twice doubling will not do, then double again, and count 8 times for board, and 64 times for timber, as in the Table you may see, which will be very slender timber.

Also between the two lines of Inches, is set four scales of equal parts, called Circumference Diameter

Diameter, Square-equal, and Square-within.

Whose Use may be thus.

The Diameter of any circle being given, to find the circumferenc or the side of a Square-equal, o the side of the square within.

Example, suppose the Diamete of a circle be 15 inches.

Take 15 from the scale calle Diameter, and measure it in th scale called, circumference and i gives 47. 10.

Also the same extent measure in the line called square-within and it gives 10.55.

For the side of a square-withi in that circle of 51 inches Diame ter.

Again, the same extent being mea sur'd in the scale call'd square-equa and it gives 13.27 for the side of square equal to a circle of 15 inche Diameter.

Lastly, this 13.27 the side of th square-equall multiplyed by it sel gives

gives 176, the Area of that Circle in Inches, whoſe Diameter is 15 Inches.

The ſame may be done, if the Circumference be firſt given, then that taken firſt from that Line, and meaſured in the other Lines, you ſhall have the reſpective Anſwers, as before.

But if the Area be firſt given, then to find the Square-equal, find the Square-root of the Area, and that root ſhall be the ſide of the Square-equal.

Example. Suppoſe the Area of a Circle be 288, what is the ſide of the Square-equal.

The middle between 1 and 288, is at near 17 the ſide of the Square-equal, for 17 ſquared is 289. Then 17 taken from the *Scale* call'd ſquare equal, gives you any of the reſt.

Theſe *Scales* ſerve to draw any Platform of a Houſe or Field very convenlently, being of ſeveral bigneſſes.

The

CHAP. II.

The definition and description of the Line of Numbers, and Numeration thereon.

THE Line of Numbers is only the Logarithmes contrived on a Ruler, and the several ranks of figures in the Logarithms are here expres'd by short, and longer, and longest division; and they are so contrived in proportion one to another, that as the Logarithmes by adding together, and substracting one from another produce the *quesita*, so here by turning a pair of Compasses forward or backward, according to due order, from one point to another, doth also bring out the *quesita* in like manner.

For the length of this Line of Numbers, know, that the longer it

is

s the better it is, and for that purpoſe it hath been contrived ſeveral ways, as firſt into a Rule of two Foot long, and three Foot long by Mr. *Gunter*, and I ſuppoſe it was therefore called *Gunter's Line*. Then that Line doubled or laid ſo together, that you might work either right on, or croſs from one to another, by Mr. *Wingate* afterwards projected in a Circle, by Mr. *Oughtred*, and alſo to ſlide one by another by the ſame Author; and laſt of all projected (and that beſt of all hitherto, for largeneſs, and conſeqenly for exactneſs) into a Serpentine, or winding circular Line, of 5, or 10, or 20 turns, or more or leſs, by Mr. *Brown*, the uſes being in all of them in a manner the ſame, only ſome with Compaſſes, as Mr. *Gunter's* and Mr. *Wingat's*; and ſome with flat Compaſſes, or an opening Index, as Mr. *Oughtred's* and Mr. *Browne's*, and one without either as the ſliding Rules; but the

Rules

Rules or Precepts that serve for the
use of one, will indifferenly serve
for any: But the projection that
shall chiefly confine my self to, is
that of Mr. *Gunter*'s; being the
most proper for to be inscribed on
a Carpenters Rule, for whose sake
I undertake this collection of the
most useful, convenient, and pro-
per applications to the uses in A-
rithmatick and Geometry. Thus
much for definition of what man-
ner of Lines of Numbers there be,
and of what I intend chiefly to
handle in this place.

The order of the divisions of
this Line of Numbers, and com-
monly on most other, is thus, it
begins with 1, and proceeds with
2, 3, 4, 5, 6, 7, 8, 9; and then
2, 3, 4, 5, 6, 7, 8, 9, 10; whose
proper power or order of nume-
ration is thus: The first 1 doth
signifie one tenth of any whole
number or integer; as one tenth
a Foot, Yard, Ell, Perch, or the
like

r, he ke; or the tenth of a penny, ſhil-
erve ng, pound, or the like, either in
hat eight, or number, or meaſure;
o, i d ſo conſequently, 2 is 2 tenths
g the three tenths; and all the ſmall
d o termediate diviſions, are 100
ſake rts of an integer, or a tenth, of
the e of the former tenths; ſo that 1
pro- the middle, is one whole integer,
n A- d 2 onwards two integers, 10 at
Thu e end is 10 integers: Thus the
man e is in its moſt proper acception
e be natural diviſion.
dy t But if you are to deal with a
eater number then 10, then 1 at
ns o beginning muſt ſignifie 1 inte-
com , and in the middle 10 integers,
us, i 10 at the end 100 integers.
wit But if you would have it to a fi-
en e more, then the firſt 1 is ten, the
vhoſ ond a hundred, the laſt 10 a
ume uſand. If you proceed further,
dot n the firſt 1 is a 100. the middle
vhol 1000, and the 10. at the end is
th o oo, which is as great a number
or th you can well diſcover, on this or
lik

 moſt

moſt ordinary lines of numbers and ſo far with convenient care you may reſolve a queſtion very exactly. Now any number being given under 10000, to find the point repreſenting it on the rule do thus.

Numeration on the Line of numbers

PROB. I.

Any whole number being given under four figures, to find the point on the Line of numbers that doth represent the ſame.

Firſt, Look for the firſt figure of your number, among the long diviſions, with figures at them, and that leads you to the firſt figure of your number: then for the ſecond figure count ſo many tenths from that long diviſions onwards, as the ſecond figure amounteth to; then for the third figure, count from the laſt tenth, ſo many centeſmes as the third figure contains; and for the fourth figure, count from

the laſt centeſme, ſo many millions, as that fourth figure hath unites, or is in value; and that ſhall be the point where the number propounded is on the line of numbers: *Take two or three Examples.*

Firſt, I would find the point upon the line of numbers repreſenting 12, now the firſt figure of this number is one, therefore I take the middle one for the firſt figure; then the next figure being 2, I count two tenths from that 1, and that ſhall be the point repreſenting 12, where uſually there is a braſs pin with a point in it.

Secondly, To find the point repreſenting 144. Firſt, as before I take for 1, the firſt figure of the number 144, the middle Figure 1 then for the ſecond Figure (*viz.* 4.) I count 4, tenths onwards for that: Laſtly, for the other 4, I count 4, centeſmes further, and that is the point for 144.

Thirdyl, To find the point repreſenting 1728. B 2 *Firſt,*

Firſt, As before, for 1000. take the middle 1, on the line

Secondly, For 7, I reckon ſeven tenths onward, and that is 700.

Thirdly, For 2, reckon two centeſmes from that *7th.* tenth for 20

And laſtly, For 8, you muſt reaſonably eſtimate that following centeſme, to be divided into 10 parts (if it be not expreſs'd, which in lines of ordinary length cannot be done) and 8, of that ſuppoſed 10. is the preciſe point for 1728, the number propounded to be found, and the like of any number whatſoever.

But if you were to find a fraction, or broken number, then you muſt conſider, that properly, or abſolutely, the line doth expreſs none but decimal fractions: thus, $\frac{1}{10}$ or $\frac{1}{100}$ or $\frac{1}{1000}$ and more nearer the rule in common acception cannot expreſs; as one inch, and one tenth, or one hundredth or one thouſandth part of an inch, foot, yard, perch,

perch, or the like, in weight, number, or time, it being capable to be applyed to any thing in a decimal way: (but if you would uſe other fractions, as quarters, half quarters, ſixteens, twelves, or the like, you may reaſonably read them, or elſe reduce them into decimals, from thoſe fractions, of which more in the following Chapters) for more plainneſs ſake, take two or three obſervations:

1. That you may call the 1. at the beginning, either one thouſand, one hundred, or one tenth, or one abſolutely, that is, one Integer, or whole number, or teninegers, or a hundred, or a thouſand integers, and the like may you call 1, in the middle, or 10 at the end.

2. That whatſoever value or denominations you put on 1 the ſame value or denomination all the other figures muſt have ſucceſſively, either increaſing forward, or decreaſing backwards, and their interme-

diate diviſions accordingly, as for example;

If I call 1 at the beginning of the line, one tenth of any integer, then 2 following muſt be two tenths, 3 three tenths, *&c.* and 1 in the middle 1 integer, 2 two integers, & 10 at the end muſt be ten integers.

But if one at the beginning be one integer, then 1 in the middle muſt be 10 integers, and 10 at the end 100 integers, and all the intermediate figures 20, 30, 40, 50, 60, 70, 80, 90 integers, and every longeſt diviſion between the figures 21, 22, 23, 24, 25, 26, *&c.* integers, and the ſhorteſt diviſions tenths of thoſe integers, and ſo in proportion infinitely: as [1^{10} 1. 10] [1. 10. 100.] [10. 100. 1000] [100. 1000. 10000.] in all which 4 examples, the firſt order of Figures, *viz.* $\frac{1}{10}$ 1. 10. 100. is repreſented by the firſt 1. on the line of numbers, the ſecond order of figures, *viz.* 1. 10. 100. 1000. is re-

epreſented by the middle 1. on the ine of numbers: the laſt order or Place of figures, *viz.* 10. 100. 1000. 10000. is repreſented by the 10, at the end of the line of numbers.

3. That I may be plain (yet further) if a number be propounded of 4 figures, having two cyphers in the middle, as 1005, it is expreſſed on the line between that prime to which it doth belong, and the next centeſm or ſmall diviſion next to it; but if you were to take 5005, where there are not ſo many diviſions, you muſt imagin them ſo to be, and reaſonably eſtimate them accordingly. Thus much for numeration on the line, or naming any point found on the Rule, in its proper value and ſignification.

Note, that ſince this Book was firſt written, I have provided a Print of the Line eleven times repeated, where the Numerator is certainly expreſſed from 0001 to 10000000; and may be had here, or in the *Minories*.

CHAP. II.

PROB. I.

Two Numbers being given, to find a third Geometrically proportional unto them; and to three, a fourth; and to four, a fifth, &c.

GEometrical proportion is when divers numbers being compar'd together, differ among themselves, increasing or decreasing, after the rate or reason of these numbers, 2. 4. 8. 16. 32. for as 2 is half 4, so is 8 half 16; and as this is continued, so it may be also discontinued, as 3. 6. 14. 28; for though 3 is half 6, and 14 half 28, yet 6 is not half 14, nor in proportion to it, as 3 is to 6. There is also Arithmetical and Musical proportion; but of that in other more large discourses, being not material to our present purpose (though I may hint it afterward.) To

To find this by the numbers, extend the Compaſſes upon the line of numbers, from one number to another; this done, if you apply that extent (upwards or downwards, as you would either increaſe or diminiſh) from either of the numbers propounded, the moveable point will ſtay on the third proportional number required. Alſo, the ſame extent applyed the ſame way from the third, will give you a fourth, and from the fourth a fifth.

Example. Let theſe two numbers 2 and 4 be propounded to find a third proportional to them (that is, to find a number that ſhall bear the ſame proportion that 2 doth to 4) and then to that third, a fourth, fifth, and ſixth, *&c.*) Extend the Compaſſes upon the firſt part of the line of numbers, from 2 to 4; this done, if you apply the ſame extent upwards from 4, the moveable point will

fall upon 8, the third proportional required; and then from 8, it will reach to 16, the fourth proportional; and from 16 to 32, the fifth; and from 32 to 64, the sixth proportional. But if you will continue the progression further, then remove the Compasses to 64 in the former part of the line, and the moveable point will stay upon 128, the seventh proportional; and from 128 to 256, the eighth; and from 256 to 512, the ninth, *&c.* Contrarily to this, if you would diminish, as from 4 to 2, extend the Compasses from 4 to 2, and the moveable point will fall on 1; and from 1 to $\frac{1}{10}$, or 5 of ten, which is one half (by the second Problem of the first Chapter) and from 5 to 25, or $\frac{1}{4}$, and so forward.

But generally in this, and most other work, make use of the small divisions in the middle of the line, that you may the better estimate the fractions of the numbers you make

make uſe on; for obſerve, look how much you miſs in ſetting of the Compaſſes to the firſt and ſecond terms, ſo much, or more will you err in the fourth: therefore the middle part will be moſt uſeful: as for example, as 8 to 11, ſo is 12 to 16, 50, or 5, if you do imagine one integer to be divided but into 10 parts, as they are on the line on a two foot Rule; but on the other end you cannot ſo well expreſs a ſmall fraction, as there you may.

PROB. II.

One number being given, to be multiplyed by another number given, to find the Product.

Extend the Compaſſes from 1 to the Multiplicator, and the ſame extent applyed the ſame way from the Multiplicand, will cauſe the moveable point to fall on the product.

Example. Let 6 be given to be

multiplyed by 5, here if you extend the Compaſſes from 1 to 5, the ſame extent will reach from 6 to 30; which number 30, though it be numbred but with 3, yet your reaſon may regulate you, to call it 30, and not 3; for look what proportion the firſt number bears to 1, the ſame muſt the other number (or Multiplicand) bear to the Product; which in this place, cannot be 3, but 30.

Another Example, for more plainneſs.

Let 125 be given to be multiplied by 144; extend the Compaſſes from 1 to 125, and the ſame extent laid the ſame way from 144, the moveable point will fall on 18000: now to read this number 18000 (ſo much, and no more) you muſt conſider, that as in 125 there is two ſignres more than in 1, ſo there muſt be two figures more in the Product 18000, than in the Multiplicand 144: and as for the order of reading the numbers, you may

may conſider well the firſt Problem of the firſt Chapter.

Some other Examples for more light.

3. As 1 to 25, ſo 30 to 750: as 1 to 8, ſo 16 to 48: as 1 to 9, ſo 9 to 81: as to 12, ſo 20 to 240. One help more I ſhall add, as to the right computation of the laſt figure in 4 figures (for more cannot be well expreſt, on ordinary lines, as that on a two foot Rule is) but for the true number of figures in the Product, note, that for the moſt part, there is as many as there is in the Multiplicator and Multiplicand put together, when the two firſt figures of the leſſer of them, do exceed ſo many of the firſt figures of the Product; but if the two firſt figures of the leaſt of them, do not exceed ſo many of the firſt figures of the Product, then it ſhall have one leſs than the Multiplicator and Multiplicand put together; as, 92 and 68 multiplied, makes 6256, four figures, becauſe

68 is more than 62; and 12 multiplied by 16, makes but 192, three figures, for the reaſon aboveſaid, becauſe 19 is more than 16. Now for right naming the laſt figure, write them down; as thus, 75 by 63; now you multiply 5 by 3, that is 15, for which you, by vulgar Arithmetick, ſet down 5, and carry 1; therefore 5 is the laſt figure in the Product, and it is 4725.

PROB. III. *Of Diviſion.*

One number being given to be divided by another, to find the Quotient.

Extend the Compaſſes from the Diviſor to 1, and the ſame extent will reach, the ſame way, from the Dividend to the Quotient; or, extend the Compaſſes from the Diviſor to the Dividend, the ſame extent ſhall reach, the ſame way, from 1 to the Quotient; as for Example.

Let 750 be a number given to be divided by 25 (the Diviſor) I extend

xtend the Compasses from 25 to , then applying of that extent the ame way from 750, the other oint of the Compasses will fall upn 30, the Quotient sought: or ou may say, as 25 is to 750, so is to 30.

2. Let 1728 be given, to be dided by 12, say, as 12 is to 1, so is 728 to 144. Extend the Compasses from 12 to 1, and the same extent shall reach the same way from 728 to 144: or as before, as 12 o 1728, so is 1 to 144.

3. If the number be a decimal raction, then you work as if it were an absolute whole number; but if it be a whole number joyned to a decimal fraction, it is wrought here as properly as a whole number: Example, I would divide 111.4 by 1.728, extend the Compasses from 1.728 to 1, the same extent applyed from 111.4, shall reach to 64.5: so again, 56.4 being to be divided by 8.75, the

Quotient will be found to be 6.45. for the extent from 8.75 to 1 being laid the ſame way from 56.4 will reach to 6.45, the Quotient, *viz.* 6, and a decimal fraction 45. To reduce this decimal fraction to the vulgar fraction found by the Pen; the ſame extent of the Compaſſes laid the contrary way from 45 the decimal fraction, gives $\frac{22}{75}$ the vulgar fraction found by the Pen, as is more apparent in the next Example.

In Diviſion by the Pen, the fraction remaining is the Numerator, and the Diviſor is the Denominator; to find which by the line, do thus, with the ſame extent of the Compaſſes that wrought the Diviſion, laid the contrary way from the decimal fraction, gives the uſual fraction when you work by the Pen. Example. To divide 522 by 34. The extent from 34 to 1 reaches from 522 to 15.35; then the ſame extent laid the contrary way

way from 35, gives 12.15, as by the Pen.

Now to know, of how many figures any Quotient ought to conſiſt, it is neceſſary to write the Dividend down, and the Diviſor under it, and ſee how often it may be written under it, for ſo many figures muſt there be in the Quotient; as in dividing this number 12231 by 27, according to the Rules of Diviſion, 27 may be written three times under the Dividend, therefore there muſt be 3 figures in the Quotient; for if you extend the Compaſſes from 27 to 1 it will reach from 12231 to 453, the Quotient ſought for.

Note, that in this, and alſo in all other Queſtions, it is beſt to order it ſo, as that the Compaſſes may be at the cloſeſt extent; for you may take a cloſe extent more eaſily and exactly than you can a large extent, as by experience you will find.

PROB.

PROB. IV.

To three numbers given to find a fourth in a direct proportion (or the Rule of Three Direct.

Extend the Compasses from the first number to the second, that done, the same extent applied the same way from the third, will reach to the fourth proportional number required.

Example. *If the Circumference of a Circle, whose Diameter is* 7, 22, *what Circumference shall a Circle have, whose Diameter is* 14?

Extend the Compasses from in the first part, to 14 in the second, and that extent applyed the same way from 22, shall reach 44, the fourth proportional required; for so much shall the Circumference of a Circle be, whose Diameter is 14. ——And the contrary, if the Circumference were given again.

Ex. 2. *If* 8 *foot of Timber worth* 10 *shilling, how much is* 1 *foot worth?*

Extend the Compaſſes from 8 to
o (either in the firſt part or ſe-
ond) the ſame extent applyed
he ſame way from 12, ſhall reach
o 15; which is the anſwer to the
ueſtion; for ſo many ſhillings is
2 foot worth at that rate.

PROB. V.

hree numbers being given, to find a fourth in an inverſed proportion, (or the Back Rule of Three.)

Extend the Compaſſes from the
rſt of the numbers given, to the
econd of the ſame denomination,
that diſtance be applyed from
he third number backwards, it
all reach to the fourth number
ought.

If 60 pence be 5 ſhillings, how
uch is 30 pence? *facit* 2. 5. two
illings, 5 tenths of a ſhilling, that
, being reduced, 2 *s.* 6 *d.*

Again, *If* 60 *Men can raiſe a reſt-work of a certain length and readth, in* 48 *hours, how long will it e ere* 40 *Men can raiſe ſuch ano-ber?*

Ex-

Extend the Compaſſes from 6
to 40, numbers of like denomina
tion, *viz.* of Men; this done, th
extent applyed the contrary wa
from 48, will reach to 72, th
fourth number you look fo
Therefore I conclude, that 4
Men will perform as much in 7
hours, as 60 Men will do in 4
hours.

Note, that this *Back Rule o*
Three, may for the moſt part, b
wrought by the *Direct Rule o*
Three.

If you do but duely conſide
the order of the Queſtion, for yo
muſt needs grant, that fewer Me
muſt have longer time, and th
contrary therefore the Anſwe
muſt be, in proportion to the Que
ſtion, which might have bee
wrought thus as well: The ex
tent from 40 to 60 will reach th
ſame way, from 48 to 72 in direct
proportion; or contrarily, as 6
to 40, ſo is 72 to 48: which yo
ſe

ee, is but turning the queſtion to
s direct operation, according to
he true reaſon of the queſtion.

Thus you have the way for the *Direct* and *Reverſe Rule of Three*: or the *Double Rule of Three*, and *Compound Rule of Three*, this is the Rule for it.

Always in the *Double Rule of Three* 5 terms are propounded, and a ſixth is required, three of which terms are of ſuppoſition, and two of demand; now the difficulty is in placing them, which is beſt done thus, as in this *Example*.

Example. *If* 5 *Scholars ſpend* 20 *l. in* 3 *months, How many pounds will ſerve* 9 *Scholars for* 6 *months?*

Note, here the terms of ſuppoſition are the firſt three, *viz.* 5, 20, and 3, and the terms of demand are 9 and 6.

Then next, for the right placing them, obſerve which of the terms of ſuppoſition is of the ſame denomination with the term required

quired, as here the 20 *l.* is of t
ſame denomination with the ho
many pounds required: ſet th
always in the ſecond place, a
the two terms of ſuppoſition o
above another in the firſt pla
and the terms of demand one
bove another in the laſt place, th

5 —— 20 —— 9
3 —— *pounds* —— 6

Then the work is performed
two ſingle *Rules of Three Dir*
thus:

Extend the Compaſſes from 5
20, the ſame extent applyed
ſame way from 9, ſhall reach
36, a fourth; this is the firſt o
ration: Then as 3 to 36, the
ſo is 6 to 72, the number of pou
required. By the Line of Nu
bers, the *Double Rule* is wrou
as ſoon as the Compound: the
fore I ſhall wave it now.

Four Queſtions and their Anſw
to ſhew the various forms of work
on the Line of Numbers.

Qu

Queſt. 1. *If* 12 *Men raiſe a Frame in* 10 *days, in how many days might* 8 *Men raiſe the like Frame?*

Reaſon tells me, that fewer Men muſt have longer time; therefore the work is thus, as 12 is to 8, ſo is 10 to 15, by the laſt Rule; or, as 8 to 10, ſo is 12 to 15.

Queſt. 2. *If* 60 *yards of Stuff, at* 3 *quarters of a yard broad, would hang a Room about; how many yards of Stuff, of half a yard broad, will ſerve to hang about the ſame Room?*

The work is thus; as 5 10*th.* to 7 10*th.* $\frac{1}{2}$, ſo is 60 to 90; or, as 75 to 5, ſo is 60 to 90, wrought backwards.

Queſt. 3. *If to make a Foot Superficial* 12 *Inches in breadth, do require* 12 *Inches in length, the breadth being* 16 *Inches, how many Inches in length muſt I have to make a Foot Superficial?*

The work is thus; as 16 is to 12, ſo is 12 to 9, the number of Inches to make a Foot. Queſt.

Queſt. 4. *If to make a Foot Solid, a Baſe of* 144 *Inches require* 12 *Inches in height, a Baſe being given of* 216 *Inches, how much in height makes a Foot Solid?*

The work then is, as 216 is to 144, ſo is 12 to 8 : or otherwiſe thus, as 12 is to 216, ſo is 144 to 8, the heighth ſought.

PROB. VI.

To three numbers given, to find a fourth in a doubled Proportion.

This Problem concerns Queſtions of proportions between Lines and Superficies : now if the denominations of the firſt and ſecond terms be of Lines, then extend the Compaſſes from the firſt term to the ſecond (of the ſame kind or denomination) this done, that extent applyed twice, the ſame way from the third term, the moveable point will ſtay upon the fourth term required.

Example. *If the Content of a Circle whoſe Diameter is* 14, *be* 154,

what will the Content of a Circle be, whose Diameter is 28?

Here 14 and 28 having the same denomination, *viz.* of lines, I extend the Compasses from 14 to 28, then applying that extent the same way, from 154 twice, the moveable point will fall on 616, the fourth proportional sought, that is, first from 154 to 308, and from 308 to 616.

But if the first denomination be of superficial content, then extend the Compasses unto the half of the distance between the first and second of the same denomination; so the same extent will reach from the third to the fourth. *Example.* *If the content of a Circle, being* 154. *have a Diameter that is* 14, *what shall the Diameter of a Circle be, whose content is* 616?

Divide the distance betwixt 154 and 616 into two equal parts, then set one foot in 14, the other shall reach to 28, the Diameter required.

The like is for Squares: *For if a Square, whose side is* 40 *foot, contain* 1600 *foot; how much shall a Square contain, whose side is* 60 *foot?*

Take the distance from 40 to 60, and apply it twice from 1600 and the moveable point will stay on 3600, the content sought for.

PROB. VII.

To three numbers given, to find a fourth in a triplicated proportion.

The use of this Problem consisteth in Questions of proportion between Lines and Solids, where if the first and second terms have denomination of Lines, then extend the Compasses from the first to the second, that extent apply thtee times from the third, will cause the moveable point to stay on the fourth proportional required. *Example.*

If an Iron Bullet, whose Diameter is 4 *Inches, shall weigh* 9 *pounds, what shall another Iron Bullet weigh, whose Diameter is* 8 *Inches?*

Extend the Compasses from 4 to 8, that extent applyed the same way three times from 9, the moveable point will fall at last on 72, the fourth proportional & weight required, that is in short, thus, as 4 to 8, so 9 to 18, so 18 to 36, so 36 to 72.

But if the two given terms be weight, or contents, of solids, and the Diameter or side of a Square or) a Line is sought for, then divide the space between the two given terms of the same Denomination into three parts, and that distance shall reach from the third to the fourth proportional.

Example. Divide the space between 9 and 72 in three parts, that third part shall reach from 8 to 4, or from 4 to 8, as the Question is propounded, either augmenting or diminishing.)

Example. *If a Cube whose side is 6 Inches, contains 216 Inches, how*

many Inches shall a Cube contain whose side is 12 Inches ?

Extend the Compasses from 6 to 12, that extent measured from 1 in the first part of the Line of Numbers three times, shall a last fall on 1728, in the second part of the Line of Numbers; for note, if you had begun on the second part, you would at three times turning, have fallen beyond the end of the line and the contrary, as above, holds here in Squares also.

PROB. VIII.

Betwixt two numbers given, to find a mean Arithmetically Proportional.

This may be done without the help of the Line of Numbers; nevertheless, because it serves to the next following, I shall here insert it, though I thought to have both this and the next over in silence; yet to set forth the excellency of Number, I have set them down. and the Rule is this:

Add half the difference of the given terms to the leſſer of them, and that aggregate (or ſumme) is the Arithmetical mean required: or add them together, and the half ſumme is the ſame. Example.

Let 20 and 80 be the terms given, now if you ſubſtract one out of the other, their difference is 60, whoſe half difference 30, added to to the leſſer term, makes 50; and that is the Arithmetical mean ſought: alſo 20 and 80 is 100, the half is 50, as before.

PROB. IX.

Between two numbers given, to find a mean Muſically proportional.

Multiply the difference of the terms by the leſſer term, and add likewiſe the ſame terms together; this done, if you divide that product by the ſumm of the terms, and to the Quotient add the leſſer term; that laſt ſumm is the Muſical mean required. Or ſhorter, thus;

Multiply the terms one by another, and divide the product by their ſumm, and the Quotient doubled is the Muſical mean required.

Example. The numbers given being 8 and 12, multiplied together, make 96, that divided by 20 the ſumm of 8 and 12, the Quotient is 4^{80}, which doubled, is $9\text{-}6^{10}$ s, the Muſical mean required. This may be done by the Line of Numbers; otherwiſe thus find the Arithmetical mean between 8 and 12, and then the Analogy or agreement is thus;

As the Arithmetical mean found *viz.* 10, is to the greater term 12 ſo is the leſſer term 8 to the Muſical mean required, $9\frac{6}{10}$.

PROB. X.

Betwixt two numbers given, to find a mean Geometrically proportional.

Divide the ſpace on the Line of Numbers, between the two extream Numbers, into two equal parts, and the point will ſtay at the mean

mean proportional required. So the extream numbers being 8 and 32, the middle point between them will be found to be 16.

PROB. XI.

Betwixt two numbers given, to find two means Geometrically proportional.

Divide the ſpace between the two extream numbers, into three equal parts, and the two middle points dividing the ſpace, ſhall ſhew the two mean proportionals. As for *Example*; let 8 and 27 be two extreams, the two means will be found to be 12 and 18; which are the two means ſought for.

PROB. XII.

To find the Square-Root of any number under 1000000.

The Square-Root of every number is always the mean proportional between 1, and that number for which you would find a Square-root; but yet, with this general caution, if the figures of

the number be even, that is, 2. 4. 6. 8 or 10. *&c.* then you must look for the unit (or one) at the beginniug of the Line, and the number in the ſecond part, and the Root in the firſt part; or rather reckon 10 at the end to be the unit, and then both Root and Square will fall backwards toward the middle 1 in the ſecond length or part of the line: but if they be odd, then the middle 1, will be moſt convenient to be counted the unity, and both Root and Square will be found from thence forward towards 10. So that according to this Rule, the ſquare of 9 will be found to be 3, the ſquare of 64 will be found to be 8, the ſquare of 144 to be 12, the ſquare of 1444 to be 38, the ſquare of 57600 to be 240, the ſquare of 972196 will be found to be 986: and ſo for any other number.

Now to know of how many figures any Root ought to conſiſt,

put a prick under the first figure, the third, the fifth, and the seventh, if there be so many; and look how many pricks, so many figures there must be in the Root.

PROB. XIII.

To find the Cube-Root of a Number under

1 0 0 0 0 0 0 0 0 0.

1 1 1 1 1

The Cube-root is always by the first of two mean proportionals between 1 and the number given, and therefore to be found by dividing the space between them into three equal parts: so by this means, the Root of 17 8 will be found to be 12, the Root of 17280 is near 26, the Root of 17 800 is almost 56, although the point on the Rule representing all the square numbers, is in one place, yet by altering the unit, it produceth various points and numbers for their respective proper Roots. The Rule to find which unit, is in this

manner: You must set (or suppose to be set) pricks under the first figure to the left hand, the fourth figure, the seventh, and the tenth; now, if by this means, the last prick to the left hand shall fall on the last figure, as it doth in 1728, then the unit will be best placed at 1 in the middle of the line, and the Root, the Square, and the Cube, will all fall forwards toward the end of the line.

But if it fall on the last but one, as it doth in 17280, then the unit may be placed at 10 in the beginning of the line; and the Cube in the second length. But if the last prick fall under the last but two, as in 172800, it doth then place the unit always at 10 in the end of the line; then the Root, the Square and Cube, will all fall backward and be found in the second part between the middle 1 and the end of the line. By these Rules it doth appear, that the Cube-root of

is 2, of 27 is 3, of 64 is 4, of 125 is 5, of 216 is 6, of 345 is 7, of 512 is 8, of 729 is 9, of 1000 is 10. As you may see by this Table of Square and Cube-roots.

Thus you have the chief Use of the Line of Numbers in general, and they that have skill in the Rule of Three, and a little knowledge in Plain Triangles, may very aptly apply it to their particular purposes; yet for their sakes for whom it is intended, I shall inlarge, to some more particular applications, in measuring all sorts of Superficies and Solids; wherein I do judge it will be most serviceable to them that be unskilful in Arithmetick, as beforesaid.

A Table of the Square and Cubique Roots

Root.	Square.	Cube.	Root.	Square.	Cube.	Root.	Square.	Cube.
1	1	1	7	49	343	204	41616	8489664
2	4	8	8	64	512			
3	9	27	9	81	729	439	192721	84604519
4	16	64	10	100	1000			
5	25	125	12	144	1728	947	896809	849278123
6	36	216	25	676	17576			
			56	3136	175616	1000	1000000	1000000000

CHAP. III.

The Use of the Line of Numbers, in measuring any Superficial measure, as Board, Glass, Plaistering, Paving, Painting, Flooring, &c.

THE ordinary measure, and most in use, is a *Two-foot Rule* divided into 24 Inches, and every Inch into 8 parts, that is, Halfs, Quarters, and Half-quarters; but these parts not agreeing with the parts on the Line of Numbers, which are Decimals or tenth parts, is bred very much trouble; and there cannot be exactness without taking of small parts, as Half quarters of Inches, or else using of Reduction; and it is also as troublesome by Arithmetick as by the Line of Numbers. To avoid

void which, I would adviſe either to meaſure altogether by Foot-meaſure (that is, a Foot divided into 1000 parts (or rather, as is ſufficient for ordinary uſe, 100) and then the diviſions on the numbers will agree fitly to the parts on your Rule, without any trouble for Fractions; for ſo doing, Fractions do become whole Numbers as it were, and are wrought accordingly: But if you uſe it not in meaſuring, yet you may have it ſet for to help you for the ready reducing of ſuch Numbers as ſhall require it, though I ſhall apply it to Inches alſo as it is commonly uſed, that it may appear uſeful both ways, accordingly as any man ſhall be affected.

The like reaſon holdeth for Inches, Yards, Ells and Perches, or any other meaſure; for thereby the work is made more eaſie, as ſhall appear anon.

Firſt

First, by Foot-measure only.

PROB. I.

The breadth of any Oblong Superficies, as a Table, Gravestone, or the like, given in Foot-measure, to find how much in length makes one Foot.

Extend the Compasses from the breadth in Foot-measure to 1, the same extent applyed the same way from 1, shall reach to the length required, to make one Foot Superficial in Foot-measure.

Exam. *At 8 tenths broad.*

Set one point of the Compasses on 8, and extend the other point to 1; the same extent being laid the same way from 1, shall reach to 1.25, the length required, being 1 Foot, and 25 parts of a hundred: For 1.25 multiplied by 08, is 100.0, or just one Foot in Decimals.

Prob.

PROB. II.

The breadth and length of any Superficies given in Foot-measure, to find the superficial Content in Foot-measure.

Extend the Compasses from 1 to the breadth, the same extent applyed the same way from the length in Foot-measure, shall reach to the superficial Content in Foot measure.

Ex. *At* 8 *tenths broad, &* 15 *f. long*

Extend the Compasses from 1 to 8, the same extent laid the same way from 15 foot the length, shall reach to 12 foot, the superficial content required.

Again, at 1.75 *broad, and* 25.30 *long*

Set one point of the Compasses in 1, and open the other to 1.7 then the same extent laid the same way from 25.30, will reach to 4 feet 275 parts, the superficial content required.

Note, the 275 parts counted foot measure, right against it

inches is 3 inches 3 tenths.

PROB. III.

The breadth of any Oblong Superficies being given in inches, to find how many inches in length makes one foot.

The extent from the inches broad to 12 being laid the same way from 12, shall reach to the inches long to make 1 foot.

Examp. *At 9 inches broad.*

Set one point in 9, open the other to 12, then the same extent laid the same way from 12, reaches to 16 inches, the length required to make 1 foot superficial: for 9 multiplied by 12 is 144, the number of superficial inches in one foot.

PROB. IV.

The breadth and length of an Oblong Superficies given in inches, to find the superficial content in like inches.

Examp. *At 30 inches broad, and 33 inches long.*

Set one point of the Compasses

in

in 1, and open the other to 183, then the ſame extent laid the ſame way from 30, ſhall reach to 5490 the true content in inches.

Now to call this 5490, and no more or leſs, obſerve, as 183 is two figures more than 1, ſo muſt 5490 be two figures more than 30, as is obſerved in the Rule of Multiplication.

PROB. V.

The length and breadth given in inches, to find the content in Superficial Feet.

The extent from 144 (the inches in one foot) to the breadth in inches, being laid the ſame way from the length in inches, ſhall reach to the content in feet.

Examp. *At* 30 *inches broad, and* 183 *long.*

Set one point in 144, and open the other to 183, the ſame extent laid the ſame way from 30, reaches to 38 foot $\frac{12}{100}$, the near content in feet required.

Pro

PROB. VI.

The breadth given in inches, and the length in feet, to find the content in Superficial Feet.

The extent from 12 to the breadth in inches, ſhall reach the ſame way from the length in feet to the ſuperficial content in feet required.

Examp. *At* 30 *inches broad, and* 15 *foot* 3 *inches long.*

Set one point in 12, and open the other to 30, the breadth in inches; then the ſame extent laid the ſame way from 15 foot 3 inches the length, reaches to 38 foot 1 inch and $\frac{1}{2}$, the true content.

PROB. VII.

The length and breadth being given in feet and inches, to find the ſuperficial content in feet & inches.

As 1 to the breadth or length in feet and inches, ſo is the length or breadth in feet and inches to the ſuperficial content in like feet and inches.

Ex-

Examp. *At* 18 *foot* 9 *inches broad, and* 30 *foot* 7 *inches long.*

Set one point always in 1, open the other to the (length or) breadth 18 foot 9 inches, then the same extent laid the same way from 30 foot 7 inches the length reaches to 573 foot 5 inches, the superficial content.

Note, if you have the line of Numbers divided into twelves for inches as before said, you may work this question more readily, and truely as I have often times made them for my own use and others also.

Note, that how broad soever any superficies is, so much is there in a foot long of that Superficies.

Examp. If a board be 3 feet 9 inches broad, there is 3 feet 9 inches in every foot long of that board, therefore (3 feet 9 inches or) the breadth in feet and parts multiplied by the length in feet and parts, give the superficial content.

Prob

PROB. VIII.

Of a Circle and his parts, as Diameter, Circumference, Square-equal and Square within, and Area of a Circle.

For the ready finding of any of these, any one being given, there is found out five numbers, in whose places on the line may be set five Center-pins for the more ready finding of them and readiness to use; which are as followeth, *Viz.*

Diameter	10.000
Circumference	31.416
Square equal	8.862
Square within	7.071
Area or Content	78.538

Thus if the Diameter of a Circle be 10 inches, then the Circumference is near 31 inches and 416 parts of 1000.

The side of the Square-equal is 8 inches 862.

The side of the Square within is 7.071.

The

The Area or Content is 78 inches 538 parts.

And any one of these being given, all the other four may be readily found by the Line of Numbers, as followeth.

Any Diameter of a Circle given to find the Circumference, &c.

The extent from 10 a fixed Diameter, to any other Diameter given, shall reach the same way from 31.416 the fixed Circumference, to the Circumference required for the given Diameter. And from the fixed side of the Square-equal to the required side of the Square-equal. And from the fixed side of the Square-within to the required side of the Square within, *&c.*

1. Examp. *Let the given Diameter of a Circle be* 15, *what is the Circumference answerable to it?* &c.

Set one point of the Compass in 10 the fixed Diameter, and the other

other in 15 the given Diameter; hen the same extent applyed the ame way from 31.416 the fixed Circumference, shall reach to 47.14 he Circumference required.

2. *To find the side of a Square-equal to a Circle of 15 inches Diameter.*

Also the same extent applyed he same way from 8.862, the fixed umber for the side of the Square-qual, shall reach to 13.30, the de of the Square-equal to the Circle required.

3. *To find the side of the Square within.*

The same extent from 10 to 15 eing laid the same way from 7.071 he fixed side of the Square ithin, shall reach to 10.61, the de of the Square within in a ircle of 15 inches Diameter re-uired.

4. *To find the Area or Content of the Circle whose Diameter is 15 inches.*

The

The same extent from 10 to 1[5] being twice repeated, the sam[e] way from 78.538 will reach t[o] 176 inches and 7 tenths, the Are[a] of a Circle of 15 inches Diameter.

PROB. IX.

The Circumference of any Cir[cle] being giv[en], to find the Diam[e]ter. the Square-equal or Squar[e] within and the Area.

Examp. *If the Circumference giv[en] be 47.14, what is the Diameter, the side of the Square-equal, Square within, and Area.*

1. Set one point in 31.416 t[he] fixed Circumference, and the [o]ther in 47.14 the given Circu[m]ference; then the same extent l[aid] from 10 the fixed Diameter, sh[all] reach to 15 the Diameter req[ui]red for a Circle of 47.14 Circu[m]ference.

2. Also the same extent l[aid] from 8.862 the fixed side of t[he] Square-equal, shall reach the sa[me] way to 13.30, the side of t[he] Squ[are]

Square — equal required.

3. Alſo the ſame extent laid the ſame way from 7.071, ſhall reach to 10.61, the ſide of the Square-within in a Circle of 15 inches Diameter required.

4. The ſame extent from 31.416 the fixed Circumference, to 47.14 the given Circumference, being twice repeated the ſame way from 78.538, the fixed Area for 10 inches Diameter, ſhall reach to 176 inches and 7 tenths, the Area of a Circle of 47.14 inches about.

PROB. X.

The Area of any Circle being given, to find the Diameter, Circumference, Square-equal, or the ſide of the Square within required.

The exact middle, or half diſtance meaſured on the Line of Numbers, between the fixed Area 78.538 and the given Area, ſhall reach from the fixed Diameter to the inquired Diameter; and from

the fixed Circumference to the inquired Circumference, and from the sides of the fixed Square-equal or within to the inquired sides of the Squares-equal or within.

Examp. *Let the given Area be* 176 inches $\frac{7}{10}$.

The exact middle between 7 538 the fixed Area, for a Circle 10 inches Diameter, and 176 inches and 7 tenths the given Area measured on a Line of Numbers.

1. Then that extent laid the same way from 10 the fixed Diameter, reaches to 15 the inquired Diameter.

2. Also the same extent laid the same way from 31.416 the fixed Circumference, gives 47.1 the Circumference required.

3. Also the same extent laid the same way from 8.862 the fixed side of the Square-equal, reaches to 13.30, the side of the Square-equal required.

4. Lastly, the same extent laid

the same way from 7.071 the fixed Number for the side of the Square within, shall reach to 10.61 the side of the Square within required for a Circle whose Area is 176 inches and 7 tenths.

PROB. XI.

Having the Area of any Circle, to find the side of a Square equal so it.

The Square-root of the given Area (found by Problem 12 of the 11*th*. Chapter) is always the side of the Square-equal to the Circles Area given; thus the Square-root of a Circle whose Area is 144 is 12, the Square-root of 144.

PROB. XII.

To find the Content of a Circle two ways.

Multiply the Diameter by it self, and multiply that product by 11, and divide this last product by 14, and the Quotient shall be the content required.

Or else multiply half the Diameter and half the Circumference together, and the product is the content required.

PROB. XIII.

How to measure a Circle, a Semicircle, or a quarter of a Circle, or any part that goeth to the Centre of the supposed Circle.

First for a Circle.

Take half the Diameter and half the Circumference, and measure it then as an Oblong Square; for the half Circle take half the Diameter and half the Semicircumference, and do likewise. Thirdly, for the quarter of a Circle, take half the Arch of that quarter, and the Radius or Semidiameter of the whole Circle, and work as you would do with an oblong square piece, and you shall have your desire.

PROB. XIV.

How to measure a Triangle.

Take half the Base and the whole Perpendicular, and work with them

them two as if it were an oblong square figure, or you may take the whole Base and half the Perpendicular.

Or, by the Line of Numbers, the extent from 2 to the Base shall reach from the Perpendicular to the Content.

PROB. XV.

How to measure a Rhombus, or a Rhomboides.

A Rhombus is a Diamond-like figure, as a quarry of Glass is, containing 4 equal sides, and two equal opposite angles: but a Rhomboides is a figure made of two equal opposite sides, and two equal opposite angles: and to measure them you must take any one side, and the neareſt distance from that side to its opposite side for the other side, and then reckon it as an oblong Square.

PROB. XVI.

How to measure a Trapezium.

A Trapezium is a figure com-

 prehended

prehended of 4 unequal ſides, and of 4 unequal angles; and before you can meaſure it, you muſt reduce it into two Triangles, by drawing a line from any two oppoſite corners, then deal with it as two Triangles; or you may ſave ſome work thus, the line you draw from corner to corner will be the common baſe to both Triangles: then ſay, as 1 is to half the Perpendiculars of both the Triangles put together, ſo the whole Baſe to the Content.

PROB. XVII.

How to meaſure a many ſided irregular figure or Polygon.

You muſt reduce it into Triangles or to Trapeziums, by drawing of lines from convenient oppoſite corners; and then the work is all one with that of the laſt Problem.

PROB. XVIII.

How to meaſure a many ſided regular figure, commonly called a regular Polygon.

Mea-

Measure all the sides, and take the half of the summ of them for one side of a square, and the nearest distance from the center of the Polygon to the middle of one of the sides for the other side of a square; and with them two numbers work as if it were a square oblong figure, and it will give the content of the Polygon desired.

PROB. XIX.

How to reduce Feet into Yards, Ells, or other parts.

First for yards, if 9 foot make one yard, how many shall 36 foot make.

The extent from 9 to 2 will reach from 36 to 4, for so many yards is 36 foot. But if you were to measure any quantity by the yard, as the plaistering or painting of a House, then I would advise you to have a yard to be divided into a hundred parts (which is as near as commonly Workmen go to, or else into 1000, if you do require

more exactness) and measure all your lengths and breadths with that, and set them down thus, 2.25 (or by 1000, thus 2.250) and the length thus 10.60, and multiply them together, and the product is the true content of the long square: the like holds for Ells, or Poles, Furlongs, or any other kind of measure. Again, for a yard in length, if 3 foot make one yard, then what shall 30 make? it maketh 10: or the contrary, if 10 yards make 30 foot, what shall 12 make? The extent from 10 to 12 will reach from 30 to 36 foot: but if it be given in feet or inches, then say, as 9 to the breadth, so is the length in feet and inches (or decimal parts) to the content in yards required.

CHAP. IV.

The Use of the Line of Numbers in measuring of Land by Perches and Acres.

Pro

in measuring any superficial Measure.

PROB. I.

Having the breadth and length of an Oblong Superficies given in Perches, to find the content in Perches.

As 1 perch to the breadth in perches, so the length in perches to the content in perches.

Examp. As 1 is to 30, so is 183 to 5490 perches.

PROB. II.

Having the length and breadth in perches, to find the content in square acres.

As 160 to the breadth in perches so is the length in perches to the content in acres.

As 160 unto 30, so is 183 : 0 34. 31 (in acres and 100 parts.

PROB. III.

Having the length and breadth of an oblong Superficies given in Chains, to find the content in Acres.

It being troublesome to divide the content in perches by 160, we may measure the length and

breadth by Chains, each Chain being 4 perches in length, and divided into a hundred links, then the work will be more easie in Arithmatick or by the Rule; for as 10 to the breadth in Chains, so the length in Chains to the content in Acres.

Examp. As 10 to 7.50, so is 45.75 to 34.81 (100 parts of an Acre.)

PROB. IV.

Having the Base and Perpendicular of a Triangle given in Perches, to find the content in Acres.

If the Perpendicular go for the length, and the whole Base for the breadth, then you must take half of the oblong for the content of the Triangle, by the second Problem, as 160 to 30, so is 183 to 34.31; or else, without halfing, say, as 320 to the Perpendicular, so is the Base to the content in Acres; as 320 unto 30, so is 183 to 17.15.

Prob.

in measuring any superficial Meas.

PROB. V.

Having the Perpendicular and Base given in Cans, to find the content in Acres.

As 20 to the perpendicular, so is the Base to the content in Acres.

As 20 to 7.50, so is 45.75 to 17. 15 parts.

PROB. VI.

Having the content of a Superficies after one kind of perch, to find the content of the same Superficies according to another kind of perch.

As the length of the second perch, is to the first, so is the content in Acres to a fourth number, and that 4*th.* number to the content in acres required. Suppose a superficies be measured with a chain 66 feet, or with a perch of 16½, and it contains 34.31, and it be demanded how many acres it would contain if it were measured with a perch of 18 foot? These kind of proportions are to be wrought by the Backward Rule

of Three, after a duplicated proportion: wherefore I extend the Compasses from 16.5 unto 18.0, and the same extent doth reach backward, first from 34.31 to 31.45, and then from 31.45 to 28.84, the content in those larger acres of 18 foot to a perch.

PROB. VII.

Having the plot of a Field with the content in Acres, to find the Scale by which it was plotted.

Suppose a plain contained 34 acres 31 centesmes, if I should measure it with a Scale of 10 in an inch, the length should be 38 chains and 12 centesmes, and the breadth 6 chains and 25 centesms, and the content according to that dimension, would by the 3*d*. Problem of this Chapter be found to be 23,82. whereas it should be 34, 31; therefore to gain the truth, I divide the distance between 23, 82 and 34.31 into two equal parts, then setting one foot of the Com-

passes

paſſes upon 10, the ſuppoſed true Scale, I find the other to extend to 12, which is the length of the Scale required.

PROB. VIII.

Having the length of the Oblong, to find the breadth of the Acre.

As the length in perches to 160 ſo is one acre to the breadth in perches. As 40 to 160, ſo is 1 to 4. Again, as 50 to 160, ſo is 1 to 3.20, ſo is 2 to 6.40; or again, if you meaſure by chains, as the length in chains to 10, ſo is 1 acre to his breadth in chains; as 12.50 unto 10, ſo 1 to 0.80; or if the length be meaſured by foot meaſure, then as the length in feet unto 43560, ſo is 1 acre to his breadth in foot meaſure.

So the length of the oblong being 792 feet, the breadth of one acre will be found to be 55 foot, the breadth of two acres 110 feet.

The uſe of this Table is to ſhew you how many inches, centeſmes

in measuring any superficial Meas.
of a chain, feet, yards, paces, perches, chains, acres, there is in a mile, either long or square, or consequently any of them all, in any of the other that is less; as for example, I would know how many inches there is in a long perch, I look on the uppermost row for perches, and in the next row under I find 198 for the quantity of inches in a long perch. But if I would know how many inches there is in a square perch, then look for perch on the left hand, and in the inch column you have 39204, for if you multiply 196 by 196, it will produce 39204.

A Tab

A neceſſary Table for Menſuration of Superficial Meaſure.

	Inch.	Centeſime.	Feet.	Yard.	Pace.	Perch.	Chain	Acre.	Mile.
Inch.	(1)	7 92	12	36	60	198	792	7920	63360
Centeſ.	62 7264	(1)	1.515	4 545	7 575	25	100	1000	8000
Feit.	144	2 295	(1)	3	5	16 5	66	660	5280
Yards.	1296	20 655	9	(1)	1 66	5 50	22	220	1760
Pace.	3600	57 381	25	2 778	(1)	3 30	13 2	132	1056
Perch.	39204	625	272. 25	30 25	10. 89	(1)	4	40	320
Chain.	627264	10000	4356	484	174. 24	16	(1)	10	80
Acre.	6272640	100000	43560	4840	1742. 4	160	10	(1)	8
Mile.	10144896	6400000	27878400	3097600	1115136	10240	640	640	(1)
Square.	Inches.	Centeſimes.	Feet.	Yards.	Paces.	Perch.	Chain	Acre.	Mile.

The like is for any other number in the whole Table, and is of very good use to reduce one number into another, or one sort of measure into another; as inches into feet, and feet into yards, and yards into perches, and perches to chains, and chains into acres, and acres into miles, or the contrary, either long-wise or square-wise; as is well known to them that have occasion for these measures. Thus much shall suffice for superficial measure, the practice of which will make it plain to any ordinary capacity.

CHAP. V.

The Use of the Line of Numbers in measuring of solid Measure, as Timber, or Stone, or such like solids.

PROB. I.

The breadth and thickness of any so-

lid

lid given, to find the side of a square that shall be equal in area to it.

Divide the space on the Line of Numbers, between the breadth and thickness, into two equal parts and the Compass point shall stay at the side of the Square-equal required.

Examp. At 6 inches thick, and 18 inches broad.

The exact middle between 6 and 18 on a true Line of Numbers, will be at 10.393, which is a Geometrical mean proportion between 6 and 18, and the side of a Square-equal, to a piece 6 inches thick, and 18 inches broad; for 10.393 squared, viz. multiplied by 10.393, produceth 108 very near, being the product of 6 times 18.

PRO B. II.

The side of the square of any solid given, to find how much in length makes a foot of solid or Timber-measure, by foot measure or inches.

The

The extent from the side of the square given in foot-measure to 1, being twice repeated or laid the same way from 1, shall reach to the length required to make a foot solid.

Examp. At 2 foot and 20 parts square, how much in length makes one foot solid.

The extent from 2.20 to 1 being laid or extended twice the same way from 1, will stay at 0.2065, the true length to make a foot solid.

For 2.20 the side of the square multiplyed by it self is 4.84, the 4.84 multiplied by 2065, the product is 999.46, which is near one foot solid.

2. If the side of the square be given in inches, then the extent from the inches square to 12, being twice repeated the same way from 12, shall reach to the inches long to make one foot.

Ex

Examp. At 15 inches square.

Set one point in 15 and the other in 12, the same extent laid twice the same way from 12, shall reach to 7 inches 68 parts, the true length to make one foot solid. For 15 inches squared is 225.

Then 225 multiplied by 7.68, produceth 1728, the cube-inches in a foot-solid.

3. For small Timber work thus. The extent from the inches square to 12 being laid two times the same way from 1, shall reach to the feet and parts in length to make one foot solid.

Examp. At 3 inches and a half square.

The extent from 3 inches and a half to 12 being laid twice the same way from 1 shall stay at 11 foot 76 parts, the length in feet to make a foot solid.

For $3\frac{1}{2}$ squared is 12.25, which multiplied by 11 foot 76 parts, produceth 144, the number of

long

long inches in a foot solid, fo
144 pieces a foot long, and on
inch square is a true solid foot o
1728 cube inches.

PROB. III.

*The breadth and thickness of any so
lid given in inches or foot me
sure, to find the length of one fo
solid.*

1. The extent from 12 to t
breadth in inches shall reach fro
the depth in inches to a fourth.

2. The extent from that fourt
number to 12 laid the same wa
from 12, shall reach to the inch
long to make one foot solid.

*Examp. At 20 inches broad a
9 inches thick, how many inches lo
makes one foot.*

1. The extent from 12 to 9 t
inches thick, being laid the sam
way from 20, the inches broa
gives 14.98 a fourth number.

2. The extent from 1498
12 being laid the same way fro
12, gives 9 inches and 60 par

he length to make one foot ſo-
id.

But for ſmall Timber work
hus.

1. The extent from 1 to the
readth, ſhall reach from the depth
o a fourth.

2. The extent from that fourth
umber to 12, laid the ſame way
rom 12, gives the length in feet
nd parts to make one foot ſolid.

Examp. At 3 inches thick and 5
nches broad.

1. The extent from 1 to 3 the
hickneſs, laid the ſame way from
inches the breadth, reaches to
4.95 a fourth.

2. The extent from 14.95 the
ourth to 12, being laid the ſame
ay from 12, gives 9 foot 60 parts
he length in feet to make one foot
olid.

For the product of 20 multipli-
d by 9 is 180, and 180 multiplied
y 9 inches 6 tenths will produce
728 the cube-inches in one foot.

So

So also for the small piece.

The 3 inches multiplied by is 15, then 15 multiplied by 9 fo 60 parts, will produce 144, as b fore, the long inches in a foot lid.

PROB. IV.

1. *At any squareness, or brea and thickness given, to find much is in a foot long.*

The extent from 12 to th ches square, laid the same from the inches square, gives quantity in one foot long.

Examp. At 4 inches squar

Set one point of the Comp in 12, and the other point i the same extent laid the same from 4 the inches square, giv inch and 33 parts, the quantit one foot long.

Which being multiplied by length of the Tree, gives the true content.

2. If the Timber is not sq then thus,

The extent from 12 to the breadth, shall reach the same way from the depth or thickness to the quantity in one foot long.

Examp. At 14 inches broad, and 8 inches thick.

The extent from 12 to 14 inches the breadth, shall reach the same way from 8 the inches thick, to 9 inches and 33 parts, the quantity or content in 1 foot long.

Then if the Tree be 20 foot long, 20 times so much is 15 foot 7 inches $\frac{4}{7}$, the true content.

PROB. V. being most used.

The side of the Square given in inches, and the length in feet, to find the content in feet and parts required.

The extent of the Compasses from 12 to the inches square, being twice repeated the same way from the length, gives the true content of the Tree required.

Examp. As 15 inches square, and 20 foot long, how much Timber is there.

See

Set one point in 12, and extend the other to 15, the inches square. Then the same extent laid twice the same way from 20 the feet long, shall reach to 31 foot 3 inches the true content required.

For 15 inches, or 1 foot 3 inches squared (or multiplied by it self) is 1.6.9 or 1 foot 6 inches $\frac{1}{4}$, and 20 times so much is 31 foot 3 inches.

PROB. VI.

The breadth and thickness of any piece given in inches, and the length in feet, to find the solid content in feet.

1. The extent from 12 to the breadth in inches, laid the same way from the depth in inches gives a fourth number.

2. The extent from that fourth number to 12 shall reach the same way from the length to the content required.

Examp. At 8 inches thick, 13 inches broad, and 19 foot long

what is the solid content in feet.

1. The extent of the Compasses from 12 to 8 inches the thickness, being laid the same way from 13 inches the breadth, shall reach to 8.66 a fourth.

2. The extent from 12 to that fourth, being laid the same way from 19 foot the length, gives 13 foot 73. (or near 9 inches) the true content in feet and parts.

For 8 inches the thickness, multiplied by 1 foot 1 inch the breadth is 0 *f.* 8 *inc.* 8.12 *pts.* then 19 foot the length, multiplied by 0 *f.* 8. *in.* 8.12 makes 13 foot 8 inches and 8.12, the exact content of a peece 8 inches thick, 13 inches broad, and 19 foot long.

PROB. VII.

The length, breadth, and depth of any solid given in inches to find the solid content in cube-inches.

1. The extent from 1 to the breadth in inches, being laid the

same way from the depth in inches, shall reach to a fourth.

2. The extent from 1 to that fourth, shall reach the same way from the length in inches to the content in cube-inches required.

Examp. At 9 inches thick, 15 inches broad, and 40 inches long.

1. Set one point of the Compasses in 1, and the other in 9 the inches thick, then the same extent laid the same way from 15 the breadth in inches, gives 13.50 a fourth.

2. Then the extent from 1 to 13.50 the fourth, laid the same way from 40 the length in inches, gives 5400 the content in inches.

For 9 multiplied by 15 is 135, and 135 multiplied by 40, is 5400.

PROB. VIII.

The length, breadth, and depth of a great solid given in feet and decimals, or in feet and inches, to find the content in feet and parts.

1. the extent from 1 to the breadth

breadth in feet and parts, ſhall reach the ſame way from the depth in feet and parts to a fourth.

2. The extent from 1 to that fourth being laid the ſame way from the length in feet and parts, ſhall reach to the content in feet and decimal parts required.

Examp. Suppoſe a Ciſtern be 3 *foot* 75 *parts* (*or* 3 *foot* 9 *inches*) *broad, and* 4 *foot* 50 *parts* (*or* 4 *foot* 6 *inches*) *deep, and* 7 *foot* 66 *parts, or* 8 *inches long, how many ſolid feet will it hold.*

1. The extent from 1 to 3.75 being laid the ſame way from 4.50 gives 16.875 for a fourth.

2. The extent from 1 to 16.875 the fourth, being laid the ſame way from 7.666 the length, gives 129 foot 3637 parts, or 4 inches and $\frac{1}{3}$.

For 3.75 multiplied by 4.50, gives 16.875 the fourth, then 16.875 multiplied by 7.66 the length, gives 129 foot 364 parts, or 4 in-

ches and $\frac{1}{3}$, which you may reduce by a look of your eye on inches and foot meaſure, laid one by the other on your Rule.

Note, every 6 foot is a full Beer Barrel, therefore 129 foot is 11 Barrels and $\frac{1}{2}$.

Note alſo, if the ſpace on the Line of Numbers between every figure, is divided into 12 proportional parts by ſmall pricks, they will repreſent inches, and be very ready in uſe, for any Learner eſpecially.

CHAP. VI.

To meaſure round Timber, by having the Diameter given in foot meaſure, or inches, and the length in feet.

PROB. I.

At any Diameter given in inches, to find how many inches in length will make one foot ſolid.

The extent from the Diameter in inches to 13.54 (the Diameter when one foot long makes 1 foot of Timber) being laid twice the

ſame

same way from 12, shall reach to the inches in length to make 1 foot.

Examp. At 10 inches Diameter.

The extent from 10 to 13.54, being laid twice the same way from 12, gives 22 inches, the length to make one foot solid.

For 78.54 the area of a Circle of 10 inches diameter, multiplied by 22 produceth 1728, the cube-inches in 1 foot solid.

PROB. II.

The Diameter given in foot measure, to find how much in length make one foot solid.

The extent from the Diameter in foot-measure to 1.128 (the Diameter in foot-measure, when one foot long makes one foot) being laid two times the same way from 1, gives the length in foot measure to make 1 foot solid, at that given Diameter.

Examp. At 0.833 Diameter, how much in length makes 1 foot solid.

The extent from 0.833 the

given Diameter to 1.128, laid twice the same way from 1, gives 1.833 the near length in foot measure to make 1 foot solid.

For 54.56 the area of a circle whose diameter is 0.833, being multiplied by 1.833, the product is 1000.045, the decimals in 1 foot solid.

PROB. III.

The Diameter given in inches, to find how much is in one foot long.

The extent from 13.54, to the Diameter in inches given, being twice repeated from 12, shall reach to the inches of Timber contained in one foot long.

Or the same extent laid twice the same way from 1, will reach to the feet and inches contained in one foot long.

Ex. At 8 inches diameter, how much is in one foot long.

Set one point in 13.54, and open the other to 8, the given Diameter in inches.

Then the same extent laid twice

twice the same way from 12, gives 41 inches $\frac{1}{4}$ the long inches of Timber in one foot long, 144 be-being one foot. Or the same extent laid twice the same way from 1, reaches to 0.348,1000 being 1 foot.

Then 0.348 multiplied by the length of the Tree in feet gives the true content.

Examp. At 15 inches diameter, and 20 foot long.

The extent from 13.54 to 15 being laid twice the same way from 12, gives 14 inches 66 parts, or laid twice from 1, gives 1 foot 223.

Then 20 times so much is 24 foot 56 parts, or 6 inches $\frac{1}{4}$.

Also 20 times 14.66 inches is 293.20 inches, 12 being one foot, which divided by 12 makes 24 foot near 7 inches.

PROB. IV.

The Diameter in inches being given of any tree or cillander, & the length in feet, to find the content in feet.

The extent from 13.54 to the

Diameter in inches, being laid twice the ſame way from the length, gives the content in feet.

Examp. At 15 inches Diameter, and 20 foot long.

The extent from 13.54 to 15, being laid twice the ſame way from 20, gives 24 foot and 42 pts. the content in feet.

Note, that right againſt 42 in feet meaſure is 5 inches in the inch meaſure. For the area of a Circle 15 inches diameter is 177, and 20 times this is 3540, which divided by 144, hath 24 foot 84 cube inches a Quotient (for 7 inches the near content.)

PROB. V.

The Diameter given in inches, and the length in inches, to find the content in inches.

The extent from 1.128 to the Diameter in inches, being laid twice the ſame way from the length in inches, gives the true content in cube-inches.

Ex-

in measuring any solid Measure.

Examp. A Well, or a Tubb of 40 inches Diameter, and 50 inches deep.

The extent from 1.128 to 40 the inches Diameter, being laid twice the same way from 50 the length in inches, gives 62900 inches, the near content in cube-inches.

Or the extent from 1.128 to 3 foot 33 parts (or 4 inches) the given Diameter laid twice from 4 foot 166 (or 4 foot 2 inches) gives 36 foot 40 parts, the content in feet and parts.

For 36 times 1728 inches is 62208 Inches, then 692 inches in the 40 part over being added makes 62900 the cube inches in that Cilander.

PROB. VI.

Having the Circumference given in inches, to find how many inches long makes one foot, or how many feet and parts long.

The extent from the Circumfe-

rence (or girt) about any Cillander given in inches, to 42.54 (the inches about, when one foot long makes one foot ſolid) the ſame extent laid twice the ſame way from 12, reaches to the inches long, to make one foot ſolid meaſure.

And the ſame extent laid twice the ſame way from 1, gives the feet long to make one foot ſolid.

Examp. Suppoſe a Tree be 30 *inches about, how many inches, or feet and inches long, makes one foot ſolid meaſure.*

The extent from 30 inches the girt, to 42.54, laid twice the ſame way from 12, gives 24 inches $\frac{1}{10}$, the inches long to make one foot.

Alſo the ſame extent laid twice the ſame way from 1, gives 2 foot 01 or $\frac{1}{100}$ part, the length in feet and parts to make 1 foot.

For 71.7 the area of a Circle of 30 inches about, being multiplied by 24.1, produceth 1728, the cube

cube inches in a foot solid.

PROB. VII.

The Girt of any Cillander given in inches, to find how many inches, or feet and inches is in one foot long.

The extent from 42.54 to the girt in inches, laid twice the same way from 12, gives the number of inches in one foot long.

Or the same extent laid twice from 1 the same way, gives the feet and parts in a foot long.

Examp. At 40 inches about.

The extent from 40 the inches about to 42.54, being laid twice the same way from 12, gives 13 inches and 63 parts, the content of one foot long.

Or the same extent laid twice the same way from 1, gives one foot, and 136 parts of 1000, the quantity in feet and parts in one foot long; which 136 parts is 1 inch, 6 tenths and a half, as is seen presently by the inches and foot

rence (or girt) about any Cillander given in inches, to 42.54 (the inches about, when one foot long makes one foot ſolid) the ſame extent laid twice the ſame way from 12, reaches to the inches long, to make one foot ſolid meaſure.

And the ſame extent laid twice the ſame way from 1, gives the feet long to make one foot ſolid.

Examp. Suppoſe a Tree be 30 *inches about, how many inches, or feet and inches long, makes one foot ſolid meaſure.*

The extent from 30 inches the girt, to 42.54, laid twice the ſame way from 12, gives 24 inches $\frac{1}{10}$, the inches long to make one foot.

Alſo the ſame extent laid twice the ſame way from 1, gives 2 foot 01 or $\frac{1}{100}$ part, the length in feet and parts to make 1 foot.

For 71.7 the area of a Circle of 30 inches about, being multiplied by 24.1, produceth 1728, the cube

cube inches in a foot ſolid.

PROB. VII.

The Girt of any Cillander given in inches, to find how many inches, or feet and inches is in one foot long.

The extent from 42.54 to the girt in inches, laid twice the ſame way from 12, gives the number of inches in one foot long.

Or rhe ſame extent laid twice from 1 the ſame way, gives the feet and parts in a foot long.

Examp. At 40 inches about.

The extent from 40 the inches about to 42.54, being laid twice the ſame way from 12, gives 13 inches and 63 parts, the content of one foot long.

Or the ſame extent laid twice the ſame way from 1, gives one foot, and 136 parts of 1000, the quantity in feet and parts in one foot long; which 136 parts is 1 inch, 6 tenths and a half, as is ſeen preſently by the inches and foot

meaſure laid together on your two foot Rule.

Then this 13 inches 63 parts, multiplied by the length of the Tree, gives the true content.

PROB. VIII.

The Circumference or Girt given in inches, and the length in feet, to find the content of any Cillender in feet and parts.

The extent from 42.54 to the inches about, being laid twice the ſame way from the length in feet, gives the content in ſolid feet required.

Examp. At 36 inches about, and 30 foot long.

The extent from 42.54 to 36 the inches girt, being laid twice the ſame way from 30 the feet long, gives 21 foot and a half, the near content in ſolid feet.

For the Area of a Circle 36 inches about, is 103.1 inches, which multiplied by 30 the length of the Cillender in feet, gives 3093

which

which ſumm divided by 144, produceth 21 foot 69 cube inches, the near content.

PROB. IX,

Having the Girt and length given in foot meaſure, to find the content in feet.

The extent from 3.545 (the feet and 100 parts about, when one foot long makes one foot of Timber) to the Girt in feet and parts.

The ſame extent laid twice from the length in feet, gives the content in feet.

Examp. A Brewers Tun of 20 *foot about, and* 4 *foot and* ½ *deep, how many ſolid feet is it.*

The extent from 3.545 to 20, ſhall reach the ſame way at two turnings from 4 foot and ½ to 143 foot and 10 parts, the ſolid content in feet: and 6 foot being a full Beer-barrel, it contains 24 barrels, Beer-meaſure.

For 31 foot 8 parts, the area of

a Circle of 20 foot about, being multiplied by 4 foot 5 parts the depth, gives 143 foot and 10 pts. as before.

PROB. X.

Having the Girt in inches, and the length of a Cillander given in inches, to find the solid content in cube inches.

The extent from 3.545 to the Girt in inches, being twice repeated the same way, from the length in inches, gives the content in inches.

Examp. At 48 *inches about, and* 24 *inches in length, how many cube inches is it.*

The extent from 3.545 to 48 the inches girt, being twice repeated from 24 the length in inches, gives 4398 the content in solid inches.

For 183.2 the area of a Circle of 48 inches about, multiplied by 24 the inches deep, produceth 4397 the near content as before.

To

To inſure you the number of places, the Print 11 times repeated, doth certainly direct you.

PROB. XI.

It being an ordinary way in meaſuring of round Timber, ſuch as *Oak*, *Elme*, *Beech*, *Pear-Tree*, and the like, (which is ſometimes very rugged, uneven, and knotty) to take a line and girt about the middle of it, and then to take the fourth part of that for the ſide of a Square equal to that Circumference: but this meaſure is not exact, but more than it ſhould be. But either becauſe of allowance for the faults aboveſaid, or for Ignorance, the cuſtome is ſtill uſed, and Men commonly think themſelves wrong'd, if they have not ſuch meaſure. Therefore I have fitted you with a Proportion for it, both for Diameter and Circumference.

And firſt for Diameter.

The Diameter given in inches, and the

in measuring any superficial Meas. the length in feet, to find the content.

As 1.526 to the Diameter, so is the length to a fourth, and that fourth to the content in feet, according to the rate aboveſaid.

The extent from 1.526 to 9.53 being twice repeated from 8, ſhall reach to 3.12, the content.

PROB. XII.

Having the Circumference in inches to find the content in the aboveſaid meaſure.

As 48 to the inches about, ſo is the length to a fourth number, and that fourth to the content. The extent from 48 to 30 being twice repeated from 8, ſhall fall upon 3.12, the content required.

PROB. XIII.

How to meaſure Taper Timber, that is, bigger at one end than at the other.

The uſual way for doing of this is to take the Circumference of the middle or mean bigneſs; but a more

more exact way, is to find the content of the base of both ends, and add them together; and then to take the half for the mean, which multiplied by the length, shall give you the true content.

Examp. A round Pillar is to be measured, whose Diameter at one end is 20 inches, at the other end it is 32 inches Diameter, and in length 16 foot (or 192 inches) the content of the little end is 314.286, the area or content of the greater end is 773.142, which put together, make 1087.428, whose half 543.714 multiplied by 192 the length, gives 104393.143 Cubical inches, which reduced into feet, is 60 feet and 713 cubical inches for the solid content of the Pillar.

PROB. XIV.

To measure a Cone, such as is a Spire of a Steeple, or the like, by having the height and Diameter of Base.

Ex-

Examp. Let a Cone be to be measured, whose Base is 10 foot, and the height thereof 12 foot, the content of the Base will be found by the 14*th.* Problem of superficial measure, to be 78.54; then this 78.54 multiplied by 4 a third part of 12, the perpendicular or height of the Cone will give 314.4, for the content of the Cone required. By the numbers work thus; the extent from 1 to 4 will reach from 78.54 to 314.4. But because there may be some trouble in getting the true perpendicular of a Cone, which is its height, take this Rule: First, take half the Diameter, and multiply it in its self, which here is 25, then measure the side of the Cone 13, and multiply that by it self which here is 169, from which take the Square of half the Base, which is 25, your first number found, and the remain is 144, the Square-root of which is the height of the Cone, or length of the perpendicular.

in meaſuring any ſolid Meaſure.

PROB. XV.

To meaſure a Globe or Sphere Arithmetically.

Cube the Diameter, then multiply that by 11, and divide by 21, gives you the true ſolid content; let a Sphere be to be meaſured whoſe Axis or Diameter is 14, that multiplied by it ſelf, gives 196, and 196 again by 14 gives 2744, this multiplied by 11 gives 30184, and this laſt divided by 21 gives 1437.67, for the content of the Sphere whoſe Diameter is 14. But more briefly, by the Numbers thus, the extent from 1 to the Axis, being twice repeated from 3.142, will reach to the ſuperficial content, that is, the ſuperficies round about. But if the ſame extent from 1 to the Axis be thrice repeated from 5238, it will reach to the ſolid content; as 1 to 14, ſo 3.142 to 617 being twice repeated, as 1 to 14, ſo 5278 to 1437 being thrice repeated. As for many ſided

ded figures, if they have length, you have sufficient for them in the Chapter of superficial measure, to find the base, and then the base multiplied by the length, giveth the content. But as for figures of roundish form, they coming very seldom in use, I shall not in this place trouble you with them, for they may be reduced to Spheres or Cones, or Trirngles, or Cubes, and then measured by those Problems accordingly. And so much for the mensuration of Solids.

CHAP. VII.

The Use of the Line of Numbers in Questions that concern Military Orders.

PROB. I.

Any number of Souldiers being propounded, to order them into a square Battle of Men.

Find by the 12*th*. Problem of the second Chapter, the square-root of the number given; for so much as

as that root ſhall be, ſo many Souldiers ought you to place in Rank, and ſo many likewiſe in File, to make a ſquare Battle of Men.

Examp. Let it be required to order 625 Souldiers into a ſquare Battle of men; the ſquare-root of that number is 25; wherefore you are to place 25 in rank, and as many in file; for Fractions in this practice are not conſiderable. For had there been but 3 leſs, there would have been but 24 in rank and file.

PROB. II.

Any number of Souldiers being propounded, to order them into a double battle of Men: that is, which may have twice as many in rank as file.

Find out the ſquare-root of half the number given, for that root is the number of men to be placed in file, and twice as many to be placed in rank, to make up a double Battle of Men.

Example.

Examp. Let 1368 Souldiers be propounded to be put in that order: I find by the 12 aforesaid, that 26, *&c.* is the square-root of 684 (half the number propounded) and therefore conclude, that 52 ought to be in rank, and 26 in file, to order so many Souldiers into a double Battle of men.

PROB. III.

Any number of Souldiers being propounded, to order them into a quadruple battle of men; that is, four times so many in Rank as File.

Here the Square-root of the fourth part of the number propounded will shew the number to be placed in File, and four times so many are to be placed in Rank.

So 2048 being divided by 4, the quotient is 512, whose root is 22 (6) and so many are to be placed in file and 88 in Rank, being four times 22, *&c.*

PROB. IV.

Any number of Souldiers being given, to-

together with their distances in Rank and File, to order them into a Square battle of ground.

Extend the Compasses from the distance in File to the distance in Rank; this done, that extent applyed the same way from the number of Souldiers propounded, will cause the moveable point to fall upon a fourth number, whose square-root is the number of men to be placed in file; by which, if you divide the whole number of Souldiers, the quotient will shew the number of men to be placed in Rank.

Examp. 2500 men are propounded to be ordered in a Square-battle of gronnd, in such sort that their distance in File being seven foot, and their distance in Rank 3 foot, the ground whereupon they stand may be a just square: To resolve this question, extend the Compasses upon the Line of Numbers downwards from 7 to 3 (then be-

becauſe the fourth number to be found, will in all likelihood conſiſt of 4 figures) if you apply that extent the ſame way from 2500, in the ſecond part among the ſmalleſt diviſions, the moveable point will fall upon the fourth number you look for, whoſe ſquare-root is the number of men to be placed in file. By which ſquare-root, if you divide the whole number of Souldiers, you have the number of men to be placed in Rank.

As 7 to 3, ſo 2500 to 1071, whoſe biggeſt ſquare-root is 32, then as 32 is to 1, ſo is 2500 to 78.

PROB. V.

Any number of Souldiers being propounded, to order them in Rank and File, according to the reaſon of any two numbers given.

This Problem is like the former, for as the proportional number given for the file, is to that given for the Rank, ſo is the number of Souldiers to a fourth number,

whoſe

whose square-root is the number of men to be placed in Rank, by which, if you divide the whole, you may have the number to be placed in File.

Examp. So if 2500 Souldiers were to be martialled in such order, that the number of men to be placed in File, might bear such proportion to the number of men to be placed in Rank, as 5 bears to 12, I say then, as 5 is to 12, so is 2500 to 6000, whose square-root is 77 the number in Rank; then as 77 is to 1, so is 2500 to 32. *&c.* The number of men to be placed in File.

CHAP. IX.

The use of the Line in questions of Interest and Annuities.

PROB. I.

A summ of Money put out to Use, and the Interest forborn for a certain time, to know what it comes to

at the end of that time, counting Interest upon Interest at any rate propounded.

Take the distance with your Compasses between 100, and the increase of 100 *l.* for one year, (which you must do very exactly) and repeat it so many times from the principal as it is forborn years and the point of the Compasses will stay on the Principal with the Interest, and increase according to the rate propounded.

Examp. I desire to know how much 125 *l.* being forborn 6 years, will be increased according to the rate of 6 *l. per Cent.* reckoning Interest upon Interest, or Compound Interest.

Extend the Compasses from 100 to 106, that extent being 6 times repeated from 125, shall reach to 177 *l.* the Principal increased with the Interest at the term of 6 years at the rate propounded.

But if it were required for any num-

number of months, then first find what 100 is at one month, then say thus, If 100 gives 10 *s.* at one month, what shall 125 be at 6 months end? *facit* 75 *s.* And the work is thus:

First say, If 100 gives 10 *s.* at one months end, what shall 125? and it makes 12 *s.* 6 *d.* then say, If one month require 12 *s.* 6 *d.* what shall 6 months require? *facit* 75 *s.* that is three pound fifteen shillings, the thing required to be found.

PROB. II.

A summ of money being due at any time to come, to know what it is worth in ready money.

This question is only the inverse of the other; for if you take the space between 106 and 100, and turn it back from the summ proposed as many times as there are years in the question, it shall fall on the summ required.

Examp. Take the distance be-

tween 106 and 100, and repeat it 6 times from 177, and it will at last fall on 125, the summ sought.

PROB. III.

A yearly Rent, Pension, or Annuity being forborn for a certain term of years, to find what the Arrears come to at any rate propounded.

First, you must find the Principal that shall answer to that Annuity, then find to what summ the Principal would be augmented at the rate and term of years propounded; then if you substract the Principal out of that summ, the remainder is the Arrears required.

Examp. A Rent, or Annuity, or Pension of 10 pound the year, forborn for 15 years, what will the Arrears thereof come to at the rate of 6 *per Cent.* Compound Interest?

The way to find the Principal that doth answer to 10 *l.* is thus: If 6 *l.* hath 100 for his Principal, what shall 10 have? *facit* 166 *l.* 16 *s.*

16 *s.* or 166 *l.* 8 *s.* for the extent from 6 to 10 will reach from 100 to 166.8. which is 166 *l.* 16 *s.* Then by the firſt Problem of this Chapter, 166 *l.* 16 *s.* forborn 15 years, will come to 398 *l.* then ſubſtract 166 *l.* 16 *s.* out of 398 *l.* and the remainder, *viz.* 231 *l.* 4 *s.* is the ſumm of the Arrears required. But note, in working this queſtion, your often turning unleſs your firſt extent be moſt preciſely exact, you may commit a groſs errour, to avoid which, divide your number of turns into 2, 3, or 4 parts, and when you have turned over one part, as here 5, for 3 times 5 is 15, open the Compaſſes from thence to the Principal, and then turn the other two turns, *viz.* 10-15, and this may avoid much errour, or at the leaſt, much mitigate it; for in theſe queſtions, the larger the Line is, the better.

PROB. IV.

A yearly Rent or Annuity being pro-

pounded, to find the worth in ready Money.

First, find by the last what the Arrears come to at the term propounded, and then what those Arrears are worth in ready Money, and that shall be the value of it in ready money.

Examp. What may a Lease of 10 *l. per annum*, having 15 years to come, be worth in ready money? I find by the last Problem, that the Arrears of 10 *l. per ann.* forborn 15 years, is worth 231 *l.* 4 *s.* And likewise I find by the second Problem that 231 *l.* 4 *s.* is worth in ready money 96 *l.* 16 *s.* and so much may a man give for a Lease of 10 *l. per ann.* for 15 years to come, at the rate of 6 *l. per cent.*

But if it were not to begin presently, but to stay a certain term longer, then you must add that time to the time of forbearance; as suppose that after 5 years it were to begin, then you must say,

231 *l.*

231 *l.* 4 *s.* forborn 20 years is worth in ready money, and it is 72 *l.* 8 *s.* and that ſhall be the value of the Leaſe required.

PROB. V.

A ſum of money being propounded, to find what Annuity to continue any number of years, at any rate propounded, that ſumm of Money will purchaſe.

Take any known Annuity, and find the value of it in ready money; this being done, the proportion will be thus; as the value found out is to the Annuity taken, ſo is the ſumm propounded to the Annuity required.

Examp. What Annuity to continue 15 years, will 800 *l.* purchaſe after the rate of 6 *l. per Cent.* Here firſt I take 10 *l. per ann.* for 15 years and find it to be worth in ready money 96 *l.* 16 *s.* by the laſt Problem; then I ſay, as 96 *l.* 8 *s.* is to 10, ſo is 800 to 82-7, which is 82 *l.* 14 *s.* and ſo much near do I con-

clude will an Annuity of 82 *l.* 14 *s.* *per ann.* be worth for 15 years, after the rate of 6 *l.* *per Cent.* viz. 800 *l.*

Also in this Impression is added the use of the *Line of Pence*, which is added to the *Line of Numbers* next to it, when it shall be desired by any one, being very convenient for casting up small summs of Money in any concern whatsoever.

The *Line of Numbers* and *Pence* together, do give the Decimal Fraction of any summ under 20 *s.* very near, as by the Print to 11 Radixes is most plainly seen.

Where 20 *s.* or 1 *l.* in Money, is at 1 in the fourth line, and 2 *s.* one tenth of a pound, at 1 right over it in the third Line; 9 farthings and 6 tenths of a farthing, being one tenth of two shillings, at 001 in the second line right over 01.

Lastly, $\frac{26}{100}$ parts of a farthing at 0001 in the first Line of Numbers

bers towards the right hand, or the $\frac{24}{1000}$ parts, at the 00001 at the left end of the ſame Line.

Therefore note, if 20*s.* is 1, 15*s.* is 075, 12*s.* is 06, 10*s.* is 05, 5*s.* is at 025, and 2*s.* or 24*d.* at 01, which on Two-foot Rules is ſet at 10 at the end of the Rule, though in this caſe called but one tenth, when 1 is one pound.

Then if 1 or 10 at the end, be 24 pence, 18 pence is at 75, 12*d.* at 5, 6*d.* at 25, 2*d.* at 8.33 in the firſt part, and 1*d.* at 4166, and 1 farthing at 1042, a little beyond the firſt 1 on Two-foot Rules.

From hence you may ſee that the Print of the eleven *Lines of Numbers* ſheweth the right Decimal Fraction of any ſumm under 1 pound *Sterling*, & by conſequence, for any ſumm above, and was purpoſely made to explain this on Two-foot Rules.

The Uſe of the Line of Numbers and Pence laid together on

Two-foot Rules, may be in a brief manner, thus;

1. At any price 100, or 5 score, what cost 1, counting 10 at the end of the Line, 10 *l.*

Examp. At 5 *l. per* 100, counted at 5 in the second part, because 10 is called 10 *l.* just over or under it in the line of pence, is 12 *d.* the exact answer, for 100 *s.* is 5 *l.*

2. *Examp.* At 2 *l.* 10 *s. per* 100, right against 2.5 on Numbers representing 2 *l.* 10 *s.* right against it on the Line of Pence is 6 *d.* the Answer, for 100 6 *d.* is 2 *l.* 10 *s.*

Now observe, if 1 in the middle is called 1 *l.* then in the first part, 9 is 18 *s.* 9.5 is 19 *s.* 5 towards the beginning-end is 10 *s.* and 1 at the very beginning end is 2 *s.*

Then to supply all under 2 *s.* to 1 farthing, begin again at the upper end at 10, where is set 24 *d.* the same with 2 *s.* and back again, 23. 22. 21. 20. 19. 18 pence at 75, then 17. 16. 15. 14. 13. 12 *d.* and

5, then 11 10. 9. 8. 7. 6 *d.* at 25; then 5. 4. 3. 2 *d.* at 0.834, then 1 penny at 0.4166, then 3 farthings, 2 farthings, 1 farthing at 0.1042, and every 10*th.* of a farthing in pricks between the farthings.

3. *Examp.* At 1 *l. per* 100, counted at the middle 1, is 2 *d.* 1 *far.* 6 tenths of a *far.* for 1.

4. *Examp.* At 10 *s. per* 100, counted at 5 in the first part, just against it in the Line of pence is 1 penny (or 4 farthings) & 8 tenths of a farthing, the true answer.

5. *Examp.* At 2 *s. per* 100, counted at 1 at the beginning of the Line of Numbers is no farthings, but 96 parts of a farthing in 100 prs. the answer for the half of 96 is 48, the farthings in 2 *s.*

6. *Examp.* But for any price under 2 *s. per* 100, count thus, as 12 *d. per* 100, just against 12 *d.* on the Line of pence is 5 on numbers, for 5 tenths of a farthing the near answer; for 5 tenths of a farthing

is half a farthing, and 100 half farthings is 50 farthings, being two farthings above 48, the farthings in one shilling.

7. *Examp.* At 6 *d. per* 100, right against 6 in the Line of pence is 025, or one quarter of a tenth of a farthing, on the Line of Numbers, the answer near the truth. For a hundred quarters of a farthing is 50 half farthings, or 25 farthings, one more than 6 *d.*

But if you count 1 farthing less for every 6 *d.* you shall have it right. *Example* at 18 *d. per* 100, count 17 *d.* and 1 *far.* 3 *far.* less than 18 *d.* and just against it on Numbers is $,\frac{11}{100}$ pts. of 1 farthing, the true price of 1.

Again, at 12 *d.* counted at 11 *d.* 2 *far.* just against it on numbers is $,\frac{11}{100}$ p s. of a farthing, the price of 1.

Again, for 6 *d.* counted at 5 *d.* 3 *far.* just against it is $,\frac{11}{100}$ pts. of a farthing, the true answer or price of 1.

I have

I have been large in this, that you might ſee the reaſon of it the plainer.

Again, on the contrary upwards, at any price for 1, what coſt 100, or 5 ſcore.

At $\frac{48}{100}$ pts. of a farthing for 1, the price of 100, is juſt 12 *d.* the contrary to the laſt example but one.

Again, at $\frac{24}{100}$ pts. of a farthing for one, 100 will coſt juſt 18 *d.* as in the laſt but two foregoing.

Again, at $\frac{96}{100}$ pts. of a farthing for 1, 100 is juſt 2 *s.* Note, the 96 is juſt againſt 23 *d.* being 4 *far.* leſs than 2 *s.* that is, 4 farthings abated for the four 6 pence's in 2 *s.*

But for all ſumms between 2 *s.* at 1 at the beginning-end, and 10 *l.* at the end of the Line. This in 3 Examples.

1 *Ex.* At 4 *s.* *per* 100 counted at 2 in the firſt part of the Line of Numbers, juſt againſt it on the Line of Pence, is 1 farthing and $\frac{24}{100}$ more for 1.

2 *Ex.*

2 *Ex.* At 13 *s. per* 100, counted at 6.5 on the Line of Numbers, just against it on the Line of Pence, is 6 farthings, 2 tenths and $\frac{1}{2}$, the answer.

3 *Ex.* At 3 *l. per* 100, counted at 3 in the second part, is 7 *d.* 0 *far.* $\frac{1}{10}$ of a farthing, the answer.

But if your 100 be 5 score and 12, then count thus with a pair of Compasses. The extent from 112 to 3 *l.* counted as before, laid the same way from the middle 1, gives 6 *d.* 1 *far.* $\frac{1}{10}$ of a farthing more for 1 *l.*

Again, on the contrary, If 1 cost 7 *d.* farthing, and half a farthing, what cost 112?

The extent from the middle 1 to 7 *d.* 1 *far.* and half a *far.* (half way beyond the prick) being laid the same way from 112, will reach to 3.45, or 3 *l.* 9 *s.* the answer. For if every figure in the second part be 1 *l.* then every 10th. cut between is 2 *s.* then 4 and $\frac{5}{10}$ and 45 is 9 *s.*

Also

Alſo, if every figure in the firſt part is 2 *s.* then 5 cuts or tenths beyond any figure is 12 *d.* 2½ is 6*d.* 1 is 2 *d.* farthing, half farthing.

Juſt as you ſee by counting 1, 2, 3, 4, 5, 6, 7, 8, 9, 10. in the ſecond part on the Numbers, juſt againſt it on the pence is the exact reduction to pence and farthings required.

Ex. Againſt 3 is 7 *d.* near a farthing, againſt 6 is 14 *d.* near 2 farthings; againſt 7.5 is juſt 18 *d.* And ſo for all other.

Again, when the price of 100 coſts above 10 *l.* then count thus.

Ex. At 65 *l.* 15 *s.* and 6 *d.* *per* 100.

Firſt, 65 doubled is 13 *s.* then the 15 *s.* 6 *d.* counted on the firſt part of the Line of Numbers at 7. 75, and juſt againſt it on the Line of pence is 7 *far.* and 44 pts. the true anſwer is 65 *l.* 15 *s.* 1*d.* 3 *far.* and 44 100 pts. of 1 farthing.

Again,

Again, at 18 *s.* 7 *d.* 2 *far.* for 1, what is the price of 100?

Note, 18 *s.* is at 9 on the first part of the Numbers, which here stands for 90 *l.* then seek the odd 7 *d.* 2 *far.* on the Line of pence, and just against it on the Line of Numbers is 3.125, the 3 is 3 *l.* the 1 more is 2 *s.* and the 25 more is 6 *d.* in all 93 *l.* 2 *s.* 6 *d.* the price of 100.

For 1800 *s.* is 90 *l.* 100 times 7 *d.* is 2 *l.* 18 *s.* 4 *d.* 100 half pence is 4 *s.* 2 *d.* in all 93 *l.* 2 *s.* 6 *d.*

Once more for a greater summ at 8 *l.* 5 *s.* 6 *d.* for 1, what costs 100.

First, to 8 *l.* add 2 Ciphers, and it is 800 *l.* then add 2 ciphers to the 5 *s.* and it is 500 *s.* or 25 *l.* then just against 6 *d.* in the line of pence in the line of Numbers is 2 *l.* 10 *s.*

In all, 827 *l.* 10 *s.* the true price of 100 at 8 *l.* 5 *s.* and 6 *d.* for 1.

A further use of the Lines of Pence and Numbers in several Questions.

1. If

If 2 pound and ½ of any Commodity coſt 7 *d.* 3 *f.* and ¼ of a *far.* what coſt 32 pound ¼ ?

The extent from 2.5 on Numbers to 7 *d.* 3 *f.* and ¼ on the Line of Pence, being laid the ſame way from 32 75, ſhall reach to 4.27.

Note, the 4 is 8 *s.* and the 27 more counted on the line of Numbers beyond the middle 1, gives on the line of Pence near 6 *d.* 2 *f.* in all 8 *s.* 6 *d.* 2 *f.* the true anſwer.

If 3 yards and ½ of Ribbon coſt 3 *d.* 3 *f.* and ½, what coſt 17 yards and ½? The extent from 3.5 on the Line of Numbers to 3 *d.* 3 *f.* and half farthing on the Line of pence, being laid the ſame way from 17.5 on the Line of Numbers reaches to 19 *d.* 1 *f.* and half on the Line of pence, the true anſwer.

3. If 1 yard of plaiſtering coſt 8 *d.* half penny, what coſt 142 yards and a half. The extent from 1 on the Line of Numbers to 8 *d.* half penny on the Line of pence, laid

the

the same way from 142½ on Numbers, reaches to 5.047; the 5 is 5*l.* and the 047 more, counted on Numbers, on the pence, is 11 *d.* farthing, the true answer.

4. If 112 *l.* cost 2 *l.* 10 *s.* 6 *d.* what cost 21 *C.* 3 *q.* and 12 ℔?

The extent from 112 to 2.525, for 2 *l.* 10 *s.* 6 *d.* laid the same way from 2448, the pounds in 21 *C.* 3 *q.* and 12 ℔. shall reach to 55 ℔ 4 *s.* the near true answer.

For if 2.525 the decimal for 2 *l.* 10 *s.* 6 *d.* be multiplied by 2448, the pounds in 21 *C.* 3 *q.* 12 ℔, the product is 6181200, which divided by 112, the quotient is 55 ℔. 189, which reduced, is near 4 *s.* or 3 *s.* 38 farthings, or 9 *d.* halfpenny.

5. If 5 ounces and a half of *Nutmegs* cost 20 *d.* 3 *far.* what shall 1 *C.* 1 *q.* 15 ℔ come to?

The extent from 5½ on Numbers to 20 *d.* 3 *q.* on the Line of pence, shall reach from 16 the ounces

ounces in 1 ℔, to 02518, the 25 is 5 *s.* and the 18 more is 1 *far.* 7 tenths, the price of 1 ℔.

Then the extent from 1 on Numbers to 2518, laid the ſame way from 155, the pounds in 1 *C.* 1 *q.* and 15 ℔, ſhall reach to 39 *l.* 0 *s.* 10 *d.* the near true anſwer to the Queſtion.

CHAP. X.

The application of the Line of Numbers to uſe in Domeſtick Affairs, as in Coals, Cheeſe, Butter, and the like.

I have added this Chapter, not that I think it abſolutely neceſſary but only becauſe I would have the abſolute applicableneſs of the Rule to any thing behinted at; for it may be the anſwer of ſome, *Do you come with a Rule to meaſure my Commodities which are ſold by weight?* Yea, ſo far as there is proportion, it concerns that and any thing elſe, the application of which

I leave

I leave to the industrious Practitioner; only I here give a hint; as much as to say, here is a Treasure, if you dig, you may find; for some may be apt to think, it being a *Carpenters-Rule*, it is fit but for *Carpenters* use only: but know, that in all measures which are either lengths, Superficials or Solids, or as some call, *Longametry*, *Planametry*, and *Solidametry*: and in all Liquids by weight or measure: and in all time, either by Years, Months, Weeks, Days, Hours, Minutes, and Seconds, and almost, (I think, I may say) in all things number is used, and in many things, proportional numbers; why then may not this Line put in for a share of use, seeing it is wholly composed of, and fitted for proportional Numbers, & of so easie an attainment for any ordinary capacity, and chiefly intended for them that be ignorant of *Arithmetick*, & have not time to learn that noble Science, as some have. And

And firſt, for more conveniency of Reduction, take theſe Rules of Reduction.

Rules for Engliſh Money.

Note, that 4 farthings make a penny; 16 farthings, 8 half pence, or 4 pence, make a groat; 48 farthings, 24 half pence, or 12 pence, make a ſhilling: 40 pence, or 10 groats, is 3 ſhillings 4 pence; 80 pence, 20 groats, or 6 ſhilling 8 pence, is a Noble; 160 pence, 40 groats, or 13 ſhillings 4 pence, is a mark; 20 ſhillings, 4 crowns, 3 nobles, or 2 angels, is a pound ſterling.

Rules for Troy-weight

Note, that 24 grains is a penny-weight; 20 penny-weights, or 24 carrots is an ounce Troy; 12 ounces is a pound; 25 lib. a quarter of a hundred, 50 lib. half a hundred, 75 lib. three quarters of a hundred, and 100 lib. is a hundred weight Troy.

Rules

Rules for Aver-du-poize weight.

Note, that 20 grains make a ſcruple; 3 ſcruples is a dram; 8 drams is an ounce; 16 ounces is a pound; 8 pound a ſtone; 28 lib. a quarter of a hundred; 56 lib. half a C. 84 lib. 3 quarters of a C. and 112 lib. or 14 ſtone, or 4 quarters of a C. is an hundred weight: 5 C. is a hogſhead weight: 19½ C. is a Fother of lead: and 20 C. is a Tun weight. And note, that *l.* ſignifies a pound in money, and lib. ſignifies a pound in weight, either Troy or Aver-du-poize.

Rules for concave Dry-meaſure.

Note, that 2 pints is a quart, 2 quarts a pottle, or quarter of a peck; 8 pints 4 quarts; 2 pottles is one gallon, or half a peck; 2 gallons is a peck; 2 pecks make half a buſhel; 4 pecks or 56 lib. make a buſhel; 2 buſhels is a ſtrike; 2 ſtrikes a coomb or half-quarter; 2 coombs 4 ſtrikes; or 8 buſhels, make a Quarter, or a Seame; 10

Quar-

Quarters, or 80 buſhels make a Laſt.

Rules for Concave Wet-meaſure.

Note, that 2 pints is a quart; 2 quarts a pottle; 2 pottles 4 quarts or 8 pints make a Gallon; 9 Gallons make a Firkin, or half a Kilderkin; 18 Gallons make 2 Firkins, a Kilderkin, or a Rundlet; 36 Gallons is 2 Kilderkins, or a Barrel; 42 Gallons make a Terce; 63 Gollons or 3 ½ Rundlets make a Hogſhead; 84 Gallons, or 2 Terces make a Tercion or Punchion; 126 Gallons is 3 Terces, 2 Hogſheads, 1 Pipe, or a But. A Tun is 252 Gallons, 14 Rundlets, 7 Barrels, 6 Terces, 4 Hogſheads, 3 Punchions, 2 Pipes, or Buts. Note, that in ſweet Oyl, 236 Gallons make a Tnn; but of Whale-Oyl 252 goes to the Tun.

Water Meaſure.

Note, that 5 pecks is a Buſhel; 3 Buſhels a Sack, 4 ½ Buſhels a Flat,

12 Sacks, 4 Flats, or 36 Bushels, make a Chaldron of Coals.

Rules for Long Measure.

Note, that 3 barley-corns make an inch; $2\frac{1}{4}$ inches make a Nail; 4 Nails, or 9 inches make a quarter of a yard; 12 inches make a Foot; 3 foot, 4 quar. 16 nails, or 36 inches make a yard; 45 inches, or 5 quarters of a yard, make an Ell; 5 foot is a pace; 6 feet, or 2 yards is a fathom; 5 yards and a half, or 16 feet and a half, is a Pole, Rod, or Perch; 160 perches in length, and 1 in breadth; or 80 perches in length and 2 in breadth; or 4 in breadth and 40 in length, make an Acre.

220 Yards, or 40 poles is a furlong; 1760 yards, 320 poles, or 8 furlongs is an *English* mile; 3 miles is a League; 20 Leagues, or 60 miles is a degree in ordinary account, and every mile a minute.

Rules for Motion and Time in Astronomy and Navigation.

Note,

Note, that a minute contains 60 ſeconds, and 60 minutes is 1 degree; and 30 degrees is 1 ſign; 2 ſigns, or 60 degrees is a ſextile ✱, 3 ſigns, or 90 degrees is a Quadrant, or quartile □; 4 ſigns, or 120 degrees a trine △; 6 ſigns, or 180 degrees is one oppoſition ☍; or ſemicircle; 12 ſigns or 360 deg. is a conjunction ☌, and the Suns Annual or Moon's monthly motion. Note alſo, every hour of time hath in motion 15 degrees: and a minute of time hath 15 minutes of motion, and one degree of motion is 4 minutes of time.

Note further, that every hour of time hath 60 minutes, therefore 45 is 3 quarters, 30 is half, 15 is a quarter of an hour; 24 hours a day natural, 7 days a week, 365 days and about 6 hours is a year. Hence it follows, that $\frac{1}{4}$ of a degree in the Heavens is 5 Leagues on the Earth, or 15 minutes of motion above, is one minute of time below, therefore a degree of

60 minutes of motion is 4 minutes of time, as before is said.

All these Rules I shall express more largely and in shorter terms, by these following Tables.

Equation for Motion.

	Signs.	Deg.	minutes.	Seconds.
Note, that the twelve Signs is	12	360	21600	1296000
One Sign is	1	30	1800	108000
One Deg. is		1	60	3600
One Min. is			1	60

Equation for Time.

	Mon.	Week.	Day.	Hour.	Minut.
One Year	13	52	305	8760	525600
Month hath	1	4	28	671	40320
Week hath		1	7	168	10080
Day natural			1	24	1440
Hour hath				1	60
Minute is					1

Equa-

in Equation:

Equation for Long-meaſure.

	Mile.	Furl.	Perch.	Yards.	Feet.	Inches.
Leag. 3	24	960	5971¼	17580	190080	
Mil. 1	—8	—340	—1760	—5280	—63360	
Furlong	—1	—40	—220	—660	—7920	
Per. Rod. Pol. 1	—	5½	—16½	—198		
Acre contains of ſqua. Perc.		160	—4840	—43560		
Acre is in { *leng.*	1	4	—220	—660	—7020	
breadth	—	4	—22	—66	—792	
1 Rood, or ¼ of an acre is in { *len.*		40				
bread.	1	— 5½	—16½	—198		
One Fathom is				6	—72	
One Ell Engliſh is				3¼	—45	
One yard is				3	—36	
One foot is				1	—12	
One inch is 1 inch 3 grains.					1	

Equation of Liquid-measure.

	Gall.	Pottl.	Quarts.	Pints.
Tun of sweet Oyl	236	472	944	1888
Tun of Wine is	252	504	1008	2016
But or Pipe is	126	252	504	1008
Tertian of Wine	84	168	336	672
Hogshead is	63	126	252	504
A Barrel of Beer or 2 Runlets of Wine — is	36	72	144	288
Kilderkin or one Runlet. is	18	36	72	144
Barrel of Ale is	32	64	128	256
Kilderkin of Ale	16	32	64	128
Firkin of Beer is	9	18	36	72
Firkin of Ale is	8	16	32	64

Equation of ſmall Dry-*meaſure, and then of great meaſure.*

	Peck.	Gal.	Pottl.	Qu.	Pi.
Buſhel of water-m. is	5	10	20	40	80
Buſhel of Land-m. is	4	8	16	32	64
One peck is		1	2	4	8-16
One Gallon is			1	2	4-8
One Pottle is				1	2-4
One Quart is					1-2

	Laſt.	weig.	Chal.	Qu.	Buſh.	Peck.	Pints,
Laſt of Dry-m.	1	2	$2\frac{1}{2}$	10	80	320	5120
One weight is		1	$1\frac{1}{4}$	5	40	160	2560
Chaldron of coals		1	4	36	144	2098	
Quarter of wheat is			1	8	32	512	
One Buſhel is				1	4	62	

Equation for Averdupoize-Weight.

	Hogsh.	C. Stons.	Lib.	Ounces.	Drams.	Scruples.	Grains.
Tun-w. gross is	4	20	280	2240	35840	286720	860160 — 17203200
One Hogshead is	1	5	70	560	8900	71680	215040 — 4300800
One C. or hund. is		1	14	112	1792	14336	43008 — 860160
One half C. is			7	56	876	7168	21504 — 430080
One quarter of C. is			$3\frac{1}{2}$	28	448	4584	10752 — 213040
One Stone is				1	8	128	1024 — 3072 — 61440
One Lib. pound is					1	16	128 — 384 — 7680
One Ounce is						1	8 — 24 — 480
One Dram is							1 — 3 — 9
One Scruple is							1 — 3

Equation for Troy-weight.

	Lib.	*Ounce.*	*Dp.*	*Carrots.*	*Grains*
C.w.	100	1200	2400	2880	57600
½ *C is*	50.	600	1200	1440	28800
¼ *C. is*	25.	300	600	720	14400
⅛ *C. is*	12½.	150	300	360	7200
Pound	1	12	340	288	5760
Ounce		1	20	24	480
One penny weight			1	1½	24
One Carrot Troy is				1	20
One Grain is					1

Equation of Money.

	Mark.	*An. Nob.*	*Cro.*	*Sh.*	*Groat.*	*Penc.*	*Far.*
Pound	½	1	1½	2	3	4	20	60	240	960
Mark is	1	1⅓	2	2⅔	4	13⅓	40	160	640	
An Angel is	1	1½	2	19	30	120	480			
A Noble is	—	1	1⅓	6⅔	20	—	80	320		
A Crown is	—	1	—	5	—	15	—	60	240	
A Shilling is	—	—	—	1	—	3	—	12	—	48
A Groat is	—	—	—	—	—	1	—	4	—	16
A Penny is	—	—	—	—	—	—	—	1	—	4

The use of which (to come to our intended purpose) may be thus. There you see how many farthings, pence, groats, shillings, and the like, is in one, or any usual piece of Coyn, also, how many ounces, scruples, in any kind of weight; and the like for measure, both liquid and dry; and also in Time: now if you would know how many there shall be in any greater number than one; then say by the Rule (or Line of Numbers) thus, If 48 farthings be one shilling, how many shillings is 144 farthings? *facit* 3 *s.* for the extent from 48 to 1, will reach from 144 to 3. and the contrary.

Again, *If a mark and a half be* 1 *pound, how many pound is* 12 *marks?* the extent from 1.50 to 1, shall reach from 12 to 8. for reason must help you not to call it 80 *l.* Again, *If* 3 *nobles be* 1 *l. what is* 312 *nobles. facit* 104 *l.* the extent from 3 to 1 will reach from 312 to 104.

Fur-

Further, *If a Chaldron of Coals coſt* 36 *s. what ſhall half a Chaldron coſt? facit* 18. (but more to the matter) *If* 36 *buſhel coſt* 30 *s. what ſhall* 5 *buſhels coſt? facit* 4. 16. that is by Reduction 4 *s.* 2 *d.* near the matter, or penny, or 3 farthings, half farthing, and better: or on the contrary; *If* 1 *buſhel coſt* 8 *d. then what coſt* 36? *facit* 288 *d.* which being brought to ſhillings, is juſt 24. which you may do thus; *If* 12 *d. be* 1 *s. how many ſhall* 288 *be? facit* 24. for the extent from 12 to 1 ſhall reach the ſame way from 288 to 24, as before. The like may be applyed to all the reſt of the Rules of weight and meaſure; of which take in fine, ſome Examples in ſhort, and their Anſwers.

If 14 *Stone be* 1 C. *what is* 91 *Stone? facit* 6 C. *and a half.*

If 1 *ounce be* 8 *drams, how many drams in* 9 *ounces? facit* 72. The extent from 1 to 8, reacheth from 9 to 72.

If 1 bushel of water-measure be 5 pecks, how many pecks is 16 bushels? *facit* 80 pecks.

If 1 barrel hold 288 pints, how much will a Firkin hold? This being the fourth part of a barrel, work thus, if 1 give 288, what 25? *facit* 72, the answer sought.

If 1 week be 7 days, how many days is 39 weeks? As 1 is to 7, so is 39 to 273. So many days in 39 weeks.

If 160 perches be 1 acre, how many acres is 395 perches? *facit* 2.492, that is near $2\frac{1}{2}$ acres.

If 8 furlongs make 1 mile, how much is 60 furlongs? *facit* $7\frac{1}{2}$ mile. For the extent from 1 to 8, gives from 60 to 7.50.

CHAP. XI.

To measure any superficies or solid by inches only (or by foot-measure) without the help of the line, by multiplication of the two sides.

PROB. I.

Poſſibly that this little Book may meet with ſome that are well skilled in Arithmetick, and being much uſed to that way, are loath to be weaned from that way, being ſo artificial and exact, yet tho they can multiply and divide very well, yet perhaps they know not this way to ſave their diviſion, and yet to take in all the fractions together, as if of one denomination: I ſhall begin firſt with foot meaſure, being the more eaſie, and I ſuppoſe my Two-foot Rule to be divided into 200 parts, and figured with 10, 20, 30, 40, 50, 60, 70, 80, 90, 100. and then ſo again to 200, as in the 3*d*. Chap. and then the work is only thus: ſet down the meaſure of one ſide of the ſquare or oblong, thus, as for example, 7.25 and 9.88, and multiply them as if they were whole numbers, and from the product cut off 4 figures, and you have the con-

tent in feet, and 1000 parts of a foot, or yard, Ell, Perch, or whatsoever else it be. Note the examples following.

7 25	12 29
9 88	19 72
58 00	24 58
580 0	860 3
6525	11061
71|6300	1229
	242|3588

For any kind of flat superficies, this is sufficient instruction to him that hath read the first part; but if it be Timber or Stone, you must thus find the base, and then another work will give you the other side, as in *Chap.* 5. *Prob.* 2. or multiply the length by the product of the breadth and thickness, and that product shall be the content required.

Prob.

PROB. II.

To multiply feet, inches, and 8 parts of an inch together without Reduction, and ſo to meaſure ſuperficial (and ſolid) meaſure.

Firſt, multiply all the whole feet, then all the feet and inches acroſs, and right on, then the parts by the feet, and alſo the inches and parts acroſs and right on; then add them together, and you ſhall have the anſwer in feet, long inches (that is in pieces of a foot long, and inch broad) ſquare inches, and 8 parts of a ſquare-inch: as for Example.

Let a piece of board be given to be meaſured that is 3. 3. 5. *i. e.* 3 foot, 3 inches, and 5 eights one way, and 2. 3. 4. the other way, I ſet the numbers down in this manner, and then right on, firſt as the line in the Scheme from 2 to 3 leads.

3. 3. 5.
2. 3. 4.

I ſay thus, 3 times 2 is 6, ſet 6 right

right under 2 and 3, as in the example in the left page: for 6 foot, as is clear, if you consider the Scheme over the example, *viz.* the squares noted with *f.* then for the next, I say cross-wise, 2 times 3 is 6, *viz.* long inches, as you may percieve by the 2 long squares marked with 9 L. and 6 L. which 6 I put in the next place to the right hand, as in the example; then for the next, *viz.* 3 times 3 is 9 (cross-wise, as the stroke from 3 to 3 shews) which 9 is also 9 long inches, as the Scheme sheweth, and must be put under 6 in the second place towards the right hand, in the Scheme it is expressed by the 3 long squares marked with L9. Then lastly for the inches, 3 times 3 is 9, going right up, as the stroke from 2 threes lead you: but note, this 9 must be set in the next place to the right hand, because they are but 9 square inches, but had the product been

above

above 12, you must have substracted the 12 out, and set them in the long inches place, and the remainder, where this 9 now standeth, and this 9 is expressed in the Scheme, by the little square in the corner mark't with (□ 9.)

Then now for the Fractions, or 8 parts of an inch, first say, crosswise, as the longest prick line doth lead you to, 3 times 4 is 12, for which 12 you must set down 1.6, that is 1 long inch, and 6 square inches; the reason is, a piece 8 half quarters of an inch broad, and 12 inches long, is a long inch, or the twelfth part of a foot superficial; and if be 12 square inches, then 4 must needs be 6 square inches: therefore instead of 12 I set down 1.6, as you may see in the example, and in the least long square of the Diagram or Scheme. Then do likewise for the other long square, which is also multiplied crosse, as 2 times 5 is 10, that is, as

I said before, 1.3 as the example and Scheme make manifest, considering what I last said, and it is marked by the 2.00. But if this or the other had come to a greater number, you must have substracted 8 as oft as you could, and set down the remainder in the place of square inches, and the number of 8 in the place of long inches, as here you see.

Then for the two shorter long squares next the corner, say crosswise again, 3 times 5 is 15, that is 1. 7, because 8 half quarters an inch long, do make 1 square-inch as well as eight half-quarters a foot long, made 1 long inch: therefore I set 1 in the place of square inches and 7 in the next place to the right hand, and it is expressed in the diagram by the small long square, and marked with * 1. 7.

Then again for the other little long square, say cross-wise, as the shorter prick line leads you, three

times

times 4 is 12, that is 1.4; and do by this as the laſt: it is noted in the Scheme by 1.4.

Then laſtly, for 5 times 4, as the ſhort prick line ſheweth you, is 20: out of which 20 take the 8 *s.* and ſet them down in the laſt place, and the 4 remaining you may either neglect (or ſet it down a place further) for you cannot ſee it on the Rule; therefore I thus adviſe, if it be under 4, neglect it quite, but if above, increaſe the next a figure more, if 4, then it is a half, and ſo may be added; for note, 64 of theſe parts make but 1 ſquare inch; of which parts the little ſquare in the right hand lower corner of the Scheme is 20, for which I ſet down 2.4, that is two half quarters and 4 of 64, which is the laſt work, as you may ſee by the Scheme and example.

Now to add them together, ſay thus, 4 is 4, which I put furtheſt to the right hand, as it were uſeleſs,

less, because not to be expressed; then 472 are 13, from which take 8, and for it carry 1 on to the next place, or as many times 1 as you find 8, and set down the remainder, which here is 5, then 1 I carried, and 13619 is 21, from which I take 12 and set down 9, because 12 square inches is 1 long inch; then 1 I carried (or more, had there been more 12s.) and 1169 is 18, from which take 12, as before, there remains 6, that is 6 long inches; and so had there been more 12. so many you must carry to the next place, because 12 long inches is one foot, lastly, 1 I carried and 6 is 7 foot, so that the work stands thus,

F. Lo. In. Sq. In, 8. 64

7——6——9——5—4

And so for any other measure Superficial or Solid.

To multiply feet, inches, and 12 parts of an inch, by feet, inches, and 12 parts of an inch.

Although the usual way of dividing

ding the line of inches, on ordinary Two-foot Rules, is into 8 parts, according to which counting the former Rule is worded, into feet, inches, and 8 parts of an inch.

Yet if every inch be divided into 12 parts, or conceived so to be, which you may easily count by calling every quarter of an inch 3, every half inch 6, every three quarters 9.

Then the parts between 3, 6, and 9 may be easily estimated by help of the half quarter cut.

Then I say, the Arithmetical multiplication will be much easier, being brought to one denomination after the way by decimals, and somewhat more exact, as will appear by this following example.

Suppose a Cedar-board be 2 foot 3 inches, and 7 twelve parts of an inch broad, and 9 foot 5 inches and 8 twelve parts of an inch long, how many superficial feet is it?

First, set down the numbers as

is

is usually done in their three denominations of feet, inches, and 12 parts, as in the example is made apparent by the black lines and the pricked lines down right and sloping from figure to figure, done so only for ease and plainness, in wording of it to a Learner.

Then proceed in the multiplication thus;

1. *First*, 2 times 9 is 18, as the down right black line from 2 to 9 sheweth, for which set down 18 foot under the 2 and 9, as in the Example.

2. *Secondly*, say 9 times 3 is 27 long inches, as the sloping black line from 9 to 3 sheweth, for which 27 you must set down 2 foot in the place of feet, and 3 in the place of long inches, because 27 long inches is 2 foot 3 inches.

3. *Thirdly*, Say 2 times 5 is 10 long inches, as the sloping black line from 2 to 5 sheweth, for which you set down only 10 long inches un-

under 5 and 3 as in the the example, becauſe it is under 12 long inches, which make 1 foot, as in the ſecond juſt before.

4. *Fourthly*, Say 3 times 5 is 15 ſquare inches, as the ſhort black line from 3 to 5 ſheweth; every 12 whereof makes 1 long inch. Therefore I ſet down 1 long inch in the place of long inches, and the 3 ſquare inches over in the place of ſquare inches right under 7 and 8.

5. *Fifthly*, Say 9 times 7 is 63 ſquare inches, as the long pricked line from 9 to 7 ſheweth, every 12 whereof makes 1 long inch, and every 144 one foot; therefore I ſet down 5 long inches in that place and 3 in the place of ſquare inches.

6. *Sixthly*, Say 2 times 8 is 16 ſquare inches, as the other long ſloping pricked line from 2 to 8 ſheweth, for which ſet down one long inch and 4 ſquare inches, each in their proper places, as in the fifth laſt mentioned.

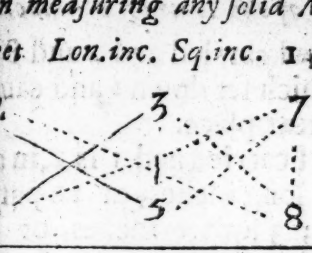
7. *Seventhly*,

7. *Seventhly*, Say 5 times 7 is 35, 144 or 12 parts of 1 ſquare inch, as the ſhorter ſloping pricked line from 5 to 7 ſheweth, every 12 whereof is 1 ſquare inch; therefore ſet down 2 in the place of ſquare inches under 7 and 8 and 11, the parts over in a ſpace beyond, under 144.

8. *Eighthly*, Say 3 times 8 is 24, 144 or 12 parts of one ſquare inch, as before, as the other ſhort ſloping pricked line ſheweth, every 12 whereof is one ſquare inch; therefore I ſet down 2 in the place of ſquare inches under 8 and 7, and no more, becauſe nothing is over 2 halves.

Laſtly, Say 7 times 8 is 56, 1728. as the ſhort down right pricked line from 7 to 8 ſheweth, every 12 whereof makes one 144, or the 12 part of 1 ſquare inch; therefore I ſet down 4 in the place of 144 & the 8 parts over in the place of 1728 *s.* being a place further, as in the example you ſee done. *Feet*

Feet Lon.inc. Sq.inc. 144. 1728.



18	3	3	11	8
2	10	3	4	
	1	4		
	5	2		
	1	2		
21	9	3	3	8

1. Then add them together, saying, 8 under 1728 is 8 and no more.

2. Then 11 and 4 is 15, set down 9 under 144, and carry 1 to the next place.

3. One I carried and 2.2.4.3,3, under the square inches, or 12 is 15, ~~for which~~ I set down 3 and carry 1 to the next place.

4. One I carried and 1.5.1.10.3 is 21, for which I set down 9 under the long inches, and carry 1 to the next place.

5. One I carried and 2 and 8 is 11, for which set down 1 and carry 1 to the next place.

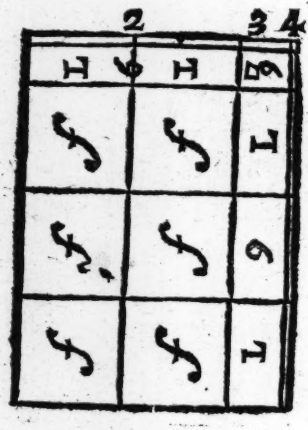
6. One I carried and 1 is 2, in all 21 foot 9 long inches, or 12 parts of a foot; 3 square inches, or 12 parts of a long inch; 3 144 or 12 parts of a square inch, and 8.1728 parts of 1 long inch.

If it be a piece of Timber or Stone; then having thus gotten the Area of the Base, then multiply that Area by the length in feet, inches, and 12 parts, and the product shall be the solid content required.

As in this Example, 1.2.4 thick, 2.1.6 broad, and 9 foot 7 inches 6 twelves long.

1	2	4	
2	1	6	
2	4	2	4
	1	8	2
		6	
		1	
2	6	5	6

2	6	5	6		
9	7	6	0		
18	6	6	11		
4	2	9	2	6	
1	3	2	4	3	6
	3	3			3
	1				
24	4	9	5	9	9


2
3 4

The Use of the
LINE of NUMBERS
ON A
SLIDING (or *GLASIERS*)
RULE,

In *Arithmatick* & *Geometry*.

AS ALSO

A most excellent contrivance of the *Line of Numbers*, for the measuring of *Timber*, either Round or Square, being the most easie, speedy, and exact as ever was used.

WHEREBY

At one setting to the length, all ordinary pieces of *Timber*, from 1 inch to 100 Foot, is with a glance of the eye resolved, without Pen or Compasses.

First drawn by Mr. White, *and since much inlarged, and made easie and useful by* John Brown.

London, Printed in the Year, 1688.

The Use of the Line of Numbers on a Sliding-Rule, for the measuring of Superficial or Solid Measures.

CHAP. I.

A Sliding-Rule is only two Rules, or Rule-pieces fitted together, with a brass socked at each end, that they slip not out of the grove; and the Line of Numbers thereon, is cut across the moving Joynt on each piece, the same divisions on both sides, only the placing of the Lines differ; for on one side of the Rule you have 1 set at the beginning, and 10 at the end on each piece; but on the other side, 1 is set in the middle, and the rest of the figures answerably both ways,

on

on purpoſe to make it large, and to take in all numbers; and the reading of this is the very ſame with the other; for if you pull out the Rule, and ſet 10 at the end, right againſt 1 at the beginning, then on both pieces you have the former Line of Numbers compleat; therefore I ſhall ſay nothing as to deſcription, or reading of it, but come ſtreight to the uſe.

On the edges of the Rule is uſually ſet Foot-meaſure, being the Foot or 12 inches parted into 100 parts; and on the flat ſides next to the foot-meaſure, inches in 8 parts, and on the other flat edges, on the other ſide, the Line of Board-meaſure, and ſometimes Timber-meaſure, whoſe uſe is ſhewed in the firſt Chapter of the Book; but note, if the Rule be a juſt foot when it is ſhut, as *Glaſiers* commonly is, then the inches are ſet alike on both ſides, and the foot-meaſure alike on both edges; and being pulled

out as far as the brasses will suffer, it wants about one inch of 2 foot just when pulled out, as it is made for Carpenters use, then the inches on one side, and Foot-measure on the same reciprocal edge, must be figured otherwise, as 13. 14. 15. 16. 17. *&c.* to 25 inches, and the Foot-measure with 110, near the end 120, 130, 140, 150, *&c.* with 210 at the very end, shewing the measure from end to end, being drawn out to any distance; as is very easie to conceive of, and need no example to illustrate it withal.

Note also in using the Line of Numbers, that that side or part of it, on which you find the first part or term in the question, shall always call the first side, and then the other must needs be the second, that the Rules and Examples may be shortned and made ealie.

1. *Multiplication by the Sliding-rule.*

Set the 1 on any side (which being found, I call the first side) to the

the Multiplicator on the other (or ſecond) ſide; then ſeek the Multiplicand on the firſt ſide where 1 was, and right againſt it on the ſecond, is the Product required.

Examp. If I would multiply 25 by 28, ſet 1 on the firſt ſide to 25 on the ſecond, then juſt againſt 28 on the firſt ſide on the ſecond is 700: for the right naming the laſt figure, and the true number of figures, you have a Rule in the 2*d.* Chapter, and 2*d.* Problem of the *Carpenters-Rule*, as in *pag.* 28.

2. *Diviſion by the Rule.*

Set the diviſor found always on the firſt ſide, to 1 on the ſecond ſide then right againſt the Dividend found out on the firſt ſide, on the ſecond is the Quotient required.

Examp. If I divide 156 by 12, the Quotient is 13; note, to find how many figures ſhall be in the Quotient, do thus, if the two firſt figures of the Diviſor be greater

than the two first figures of the Dividend, then the quotient hath so many places or figures as there is more in the Dividend than in the Divisor; but if it be less, that is to say, the Dividends two first figures greater than the Divisors, then the quotient shall have one place or figure more: then the Dividend exceeds the Divisor.

Examp. 2964 divided by 39, makes a quotient 76, of 2 figures, but if you divide the same number by 18, you shall have the figures in the quotient, *viz.* 164, and 12 remaining, or by the Rule, 2 third parts of one more, for the reason aboveſaid, the two first figures of the dividend being greater than the Divisor, it must have one place more than the difference of the number of figures in the Multiplicator and Multiplicand.

3. *The Rule of 3 Direct.*

Set the first term of the question sought out on the first side, to the second

cond term of the queſtion on the ſecond (or other) ſide: then right againſt the 3*d.* term found out on the 1*ſt.* ſide, on the 2*d.* ſide is the 4*th.* proportional term required.

Examp. If 2 *yards of Cloth coſt* 8 *s. what coſt* 11 *yards* $\frac{1}{2}$ *?* The anſwer is 46 *s.* for if you ſet 2 on any one ſide to 8 on the other, then look for 11$\frac{1}{2}$ on the firſt ſide where 2 was, and right againſt it on the ſecond you ſhall find 46, the number required. Note, that all your fractions on the Line of Numbers are decimal fractions, and to work them, you muſt reduce your proper fractions to them, which for ordinary fractions, you may do it by inches and foot-meaſure; but this general Rule by the Numbers will reduce any kind whatſoever, as thus; ſuppoſe I would have the decimal fraction of 9 foot, 7 inch. $\frac{1}{4}$, firſt note that 9 are integers, for the reſt, ſay thus, as 48 the number of quarters in (12 inches or) 1 foot

is 1000, so is 31 the number of quarters in 7 inches 3 quarters to 645 the decimal fract on required, for 9645 is equal to 9 foot 7 inches $\frac{3}{4}$; & so for any other whatsoever.

4. *To work the Rule of 3 Reverse.*

Set the first term sought out on the first side, to the second, being of the same denomination on the 2*d.* line or side, then seek the third term on the 2*d.* side, and on the 1*st.* you shall have the answer requir'd.

Ex. If 48 *men perform a piece of work in* 24 *hours, how many men may there be to do the like in* 4 *hours?* Set 24 on the first side, to 4 on the second, then right against 48 found out on the second, on the first is 288, the number of men required.

5. *To work the double Rule of* 3 *direct.*

To perform this, you must have two workings; as thus, for an

Examp. If the increase of 3 *bushels of Wheat in one year, be* 36 *bushels, what shall the increase of* 8 *bushels be for* 7 *years?*

First,

First, ſet 3 on the firſt ſide, to 36 on the ſecond, then againſt 8 on the firſt, on the ſecond you find 96, then ſet 10 on the firſt ſide to 96, then againſt 7 on the firſt ſide on the ſecond you have 672, the increaſe in 7 years, the anſwer required.

CHAP. II.

To meaſure Board or Glaſs by the Sliding-rule, the length and breadth being given.

PROB. I.

The breadth given, to find how much makes a foot.

If the breadth be given in inches then ſet 12 on the firſt ſide, to the inches on the ſecond; then right againſt 12 on the ſecond, on the firſt is the number of inches required.

Examp. At 6 inches broad ſet 12 to 6, then againſt 12 on the ſecond on the firſt you have 24 But if it be given in foot-meaſure, then inſtead of 12 uſe 1, and do in like manner as before.

Examp. At 0.50 broad, ſet 1 to 0.50, then right againſt the other 1 is 2.00 the anſwer required.

But to find how much is in a foot long at any breadth, do thus:

Firſt, for foot-meaſure, juſt as the Rule ſtands even look for the breadth on one ſide, and the quantity in a foot is on the other ſide: but for inches ſet 1 to 12, then right againſt the inches broad is the feet and tenths in a foot long.

Ex. At 6 inches broad is 500 half a foot in a foot long. Again at 30 inches broad is 2 foot and a half in a foot long.

PROB. II.

The length and breadth given, to find the content.

Firſt, the breadth given in inches and the length in feet and inches ſet 12 on the *1ſt.* ſide to the breadth on the ſecond, then right againſt the length on the firſt, on the ſecond is the content required.

Ex. At 16 inches broad and

foot long: Set 12 to 16, then right againſt 20 you have 26 foot 7 10*th*. look for the 7 10*th*. on the foot-meaſure, and right againſt it on the inches you have 8 inches and ¼ and ⅛ quarter, the anſwer deſired.

But if the breadth be given in foot-meaſure, then ſet 1 to the breadth; then right againſt the length on the firſt ſide, on the ſecond you ſhall have the content required.

Ex. At 1.20 broad, 20.00 foot long, you ſhall find 24 foot. For if you ſet 1.0 1.20, then right againſt 20 foot, you have on the 2*d*. 24 as before. *PROB.* III.

The breadth given in feet and inches and the length alſo in the ſame parts, to find the content.

Set 1 on the firſt ſide to the feet and inches brought to a decimal fraction, or as near as you can gueſs (for 6 inches is half, 3 inches is 1 quarter, 9 inches is 3 quarters, 4 inches is one third, 8 inches is two

thirds, and 1 inch is somewhat less than 1 tenth on Rule) on the other or second side; then right against the length found on the first, on the second is the content required.

Ex. At 3 foot 3 inches broad, and 9 foot 9 inches long, you shall have 31 foot 8 inches $\frac{1}{2}$ near, the very same is for foot-measure (only much easier) because the divisions on the Line of Numbers, and on the Line of foot-measure on the edge, do agree together.

This being premised as to the using of it, you may apply all the former precepts and examples to this Rule as well as the other.

CHAP. III.

To measure Timber by the Sliding-Rule. *PROB.* I.

To measure Timber by this Rule, is nothing else but to work the *Double Rule of Three.*

Examp. At 8 inches square & 20 foot long, I would know the content. Set 12, if the side of the square be

be given in inches (or 1, if in foot measure) on the first side, to 8 the inches square on the second: then right against 12 on the second side on the first is 18, the fourth proportional part: then for the second work, set 18, the fourth proportional last found to 8 the inches square on the second, then right against 20 the length, is 9, the content required. Or rather thus;

Set 12 against 8, then right against 20 on the same side 12 was, is 13.5 near on, then look for 13.5 *fere* on the first side, and right against it on the second is 9 foot the content required.

PROB. II.

To measure a piece that is not square

Set 12 if you use the inches (or 1 if you use foot-measure) on the first side, to the inches thick on the second; then right against the inches broad on the first side, on the second is a fourth proportional: then in the second operation, set 2 on the first side to the fourth pro-

proportional on the ſecond, then right againſt the length on the firſt ſide, on the ſecond is the content required.

Ex. At 8 inches thick and 16 broad, and 20 foot long, you ſhall find 18 foot *fere*.

PROB. III.

The ſquare given, to find how much makes a foot.

Set the inches ſquare on the firſt ſide, to 12 on the ſecond; then right againſt 12 on the firſt, on the ſecond is a fourth proportional number: then in the ſecond work, as the inches ſquare to the fourth proportional, ſo is 12 to the number of inches required, to make a foot of Timber.

Ex. At 6 inches ſquare, ſet 6 to 12, then againſt the other 12 is 24: then ſet 6 to 24, then right againſt 12 you ſhall have 48, the length in inches required.

After the ſame manner are other queſtions wrought, but the Compaſſes

passes are easier and more ready; therefore I shall say no more to this but only refer you to the former Rules in the third, fourth and fifth Chapters. Only note, that in those *Sliding-rules* made for *Glasiers* use, the one half of the Line of Numbers is on one side of the Rule, and the other on the other side; and whatsoever leg or piece of the rule is the first on the one side, the same leg or piece is the first, when the Rule is turned, on the other side, which must well be observed; but note, that for measuring of Timber, those that use it may have one side fitted for that, as I shall more plainly and fully shew in the next chapter, being the easiest, speediest and nearest way that ever yet was used by any man, resolving any Contents by having the length and the diameter, the circumference or square given.

A Table

A Table of the true size of Glaſiers Quarries, both long and ſquare, calculated by J. B.

Quarres.

Square-Quarries 77.19 gr.

	Rang. Sides	bread. leng.	content in feet	content in inc
8	in100 i. 100	l. p i. prs.	F. p rrs	Inc. p.
8	4 20- 4 30	5 36 6 70	0 1250	I. 50
10	3 76 3 84	4 80 6 00	0. 1000	I. 20
12	3 43 3 51	4 38 5 47	0 0833	I. 00
15	3 07 3 13	3 92- 4 90	0. 0667	0. 80
18	2 80 2 86.	3 57 4 47.	0. 0555	0. 666
20	2 66. 2 72	3 39 4 24	0. 5000	0. 60

Quarries.

Long Quarries 67.22

	Rang. Sides	bread. leng.	content	conteng
	in pts. l. pts.	. 100 . pts.	F. 100	I. pts.
8	4 09 4 41.	4. 90 7. 34	0. 1250	I. 50
10	3 65- 3. 95	4. 38- 6. 57	0. 1000	I. 20
12	3 34 3 61	4 00 6. 00	0. 0833	I. 00
15	2 98. 3 23	3. 58 5. 37	0. 0667	0. 80
18	2 58 2 79-	3. 10 4 90	0. 0555	0. 666
20	2 72- 2 94-	3. 27 4. 65	0. 0500	0. 60

Note, that a prick after the 100 parts of an inch, notes a quarter, and a ſtroke (-) a half of 100 parts of an inch; to make this Table, work thus by the *Line of Numbers*.

Divide the diſtance between the content of ſome known ſize, as ſquare 10*s*. or long 12*s*. and the content of the inquired ſize, into two equal parts, for that diſtance laid the right way (increaſing for a bigger, or decreaſing for a leſs) from the ſides of the known ſize, ſhall give the reciprocal ſides of the inquired ſize.

Example for ſquare 12*s*.

The half diſtance on the Line of Numbers, between 100 the content of ſquare 10*s*. and 0.833 the content of ſquare 12*s*. ſhall reach from 6 the length of ſquare 10*s*. to 5.47 the length of ſquare 12*s*. and from 4.80 the breadth of ſquare 10*s*. to 4 38- the breadth of ſquare 12*s*. and from 3 84- to 3.51, and from 3 76 to 3 43; and ſo for all the reſt.

CHAP. IV.

The description of the Line of Numbers on a Sliding-rule, to measure Solid measure only, according to Mr. White's *first contrivance, but much augmented by* J. B.

First, when the figures on the Timber side) stand right towards you, fit to read, then that half or piece next to your right hand, I call the right side, the other is of necessity the left.

Secondly, the figures on the right side are, first at the lower end, (where the brass is pin'd fast) either 3, or 4, or 5, it matters not much which, yet to have 3 there is best; then upwards, 4.5.6.7.8.9. 10.11. for so many inches then 1.2 3.4.5 6.7.8 9.10.11.12. under the brass at the top, for so many feet, the divisions between to 1 foot, are quarters of inches, the next above 1 foot, are only whole inches, as you may plainly see.

Thirdly, at 1 foot you have the word

word ſquare, at 1 foot, 1 inch ½ is a mark, and right againſt it is ſet TD, noting the true diameter of a round Cylinder; at an inch further is 12 ſet, which I call ſmall 12, being in ſmall figures. Again at 1 foot 3 inches better, is another mark, and right againſt it the word diameter, for the diameter of a piece of timber according to the uſual engliſh allowance. Then again at 3 foot 6 inches ½ near, is TR, for the true circumference of a round cillander. Laſtly, at 4 foot is the word round, noting the circumference according to the uſual allowance, whoſe uſe followeth. Alſo at 13 foot 7 inches is TD, and at 3 inches and ½ is TR.

Note alſo, if you put on the Gage-points for Ale or Wine, with the mean diameter, and length, you may gage any Wine or Beer-veſſel, the Wine at 17 inches 15. the Ale or Beer at 18.95. Alſo the Gage-points for a Beer-barrel at 35 inches

ches and 9525 parts; and the gage-point for a barrel of Ale at 33 inches and 89645 parts.

Fourthly, the figures on the left side are not much unlike the right, for 1 at the beginning is one inch, and so it proceeds by quarters of inches to 1 foot; then by figures at the feet, and the divisions all whole inches to 10 foot, then every whole foot, and half, and quarter, or 10th, to 100, or 140, or 150 foot; and this I call the left side, the other the right side; so that from 1 inch at the lower end to one foot, every inch hath a figure; from 1 foot to 10 foot, every foot hath a figure, and from 10 foot to 100, every 10th. foot only is figured. I have been very plain in explaining this, because I would avoid vain repetitions in the following uses, wherein you shall have first the most ordinary and easie questions, and then the more hard and critical, and less useful. The Uses follow.

PROB.

PROB. I.

A piece of Timber being not ſquare, to make it ſquare, or to find the Square-equal.

Set the breadth on the left ſide, to the breadth on the right, then right againſt the inch and quarters thick found on the left ſide, on the right is the inches ſquare required.

Examp. At 18 broad and 6 thick you ſhall find 10 inches $\frac{1}{8}$, the ſide of the ſquare required.

For if you ſet 6 inches againſt 6 inches, on the right and left ſide: then right againſt 18 inches, or 1 foot 6 inches on the left, on the right you have 10 inches 1 quarter, and half a quarter; for the ſide of the ſquare-equal to 18 one way, and 6 the other way.

PROB. II.

The ſide of the ſquare given, to find how much makes a foot.

For all pieces between 3 or 4 inches and 42 inches ſquare, which are the moſt uſeful: this the beſt way

way, set the inches or feet, and inches square, found out on the right side, to one foot on the left, then right against 1 foot on the right, on the left is the inches or feet, and inches required to make a foot of Timber. But when the piece is small, count 1 foot on the right for 1 inch, and call 12 on the right for 1 foot. *Example.*

At 8 inches square set 8 on the right, to 1 foot on the left, then right against 1 foot on the right, on the left is 2 foot 3 inches, the length required.

To find how much is in a foot long.

Just as the Rule stands even, look for the inches the piece is square on the right, and on the left is the inches or feet, and inches required.

Example. At 17 inches square, there is 2 foot of timber in 1 foot long, which if you multiply by the length, you shall have the true content. A very good way for large pieces, and very exact.

PROB.

PROB. III.

The ſide of the ſquare, and length given, to find the content.

For all pieces between 1 inch or ¼ part of a foot, and 100 foot, this is the eaſieſt way. Set the word ſquare or 1 foot to the length on the left, then right againſt the *inches* or *feet* and *inches* ſquare on the right, on the left you have the content.

Examp. At 9 inches ſquare and 20 foot long; ſet the (long ſtroke by the) word ſquare, to 20 foot on the left, then right againſt 9 inches on the right ſide, on the left ſide you have 11 foot and a quarter, the content required.

But if it be a very great piece, as above 100 foot, then call 1 foot on the left ſide 10 foot, and 2 foot 20, *&c.* then 10 ſhall be 100, and 100, a 1000, that will ſupply to 1500 foot in a piece.

But for all ſmall pieces under 3 inches ſquare, and above 1 quarter of an inch, do thus: Set 12 on the

top

top (or the small 12 when it is most convenient to use) to the length on the left side, then right against the inches (or 12*s*. of 1 inch) squares found on the right side, on the left is the true content required. *Example.*

At 2 inches (3 twelves or) 1 quarter square, and 10 foot long, you shall find 4 inches and a quarter *ferè*, But note, when you use the small 12, the answer is given in decimals of a foot, therefore the top 12 is best.

ROB. IV.

The square of a small piecè of Timber given, to find how much makes a Foot.

For all pieces from 12 inches to 1 inch square, do thus; set the inches and (12*s*. or) quarters square, counting 1 foot on the right side for 1 inch, and 2 foot for 2 inches, *&c.* found out on the right side to 100 on the left; then right against the upper, or small 12 on the right

right, on the left is the length required to make a foot of Timber.

Examp. At 2 inches $\frac{1}{4}$ ſquare, you muſt have 28 foot 4 inches, to make a foot.

PROB. V.

Under 1 *inch ſquare, to find the length of a foot.*

Set 1 foot 9 inches, 6 inches or 3 inches, found on the right ſide, for 1 inch $\frac{1}{4}$, $\frac{1}{2}$, or $\frac{1}{4}$ of an inch, againſt 10 on the left ſide, counted for 100: then right againſt the ſmall 12 you have the feet in length required.

Examp. At 1 inch ſquare you find 144 feet, at $\frac{3}{4}$ ſquare 256 feet, at $\frac{1}{2}$ an inch ſquare 576 feet, at $\frac{1}{4}$ or an inch ſquare, you find 2034 feet in length, to make 1 foot of Timber.

Or, if you ſet the former numbers 12, 9, 6, 1, againſt 1 inch on the left, then right againſt the upper 12 is a number, which multiplied by 12, is the number of feet required.

PROB. VI.

A great piece above 3 *foot* $\frac{1}{2}$ *ſquare, to find the length of a foot.*

I Set

Set the feet and inches on th
right, to 100 on the left; the
right against small 12 is the inche
and 12*s.* or 12*s.* of a 12*th.* tha
goes to make a foot.

Examp. At 4 foot square, yo
have 9. 12*ths.* or ¾ of an inch
make a foot of Timber; at 5 foo
square, 5. 12*ths.* and 10. 12*ths.*
a 12*th.* to make a foot.

Thus you see the Rule as no
contrived, resolves from 1 quarte
square, to 12 foot square, the co
tent or quantity of a foot of Tim
ber in length at any squarenes
without Pen or Compasses.

CHAP. V.

For round Timber.

PROB. I.

The number of inches that a piece of Timber is about, being given, to find how much makes a foot.

First, for all ordinary pieces, s
1 foot. on the left, to the inches
feet, and inches above on the righ

then right against TR for true mea-
ure, or round for the uſual mea-
ure, is the feet, or feet and inches
equired to make a foot of Tim-
er at that circumference about.

Examp. At 4 inches about, 1 13
oot 2 inches is for true meaſure,
ut for the uſual meaſure, 1 42 foot
goes to make a foot of Timber.

At 12 foot 3 inches about, 1 inch
is a true foot, but for the uſual al-
owance, as the fourth part of a
ine girt about gives: it muſt be 1
inch $\frac{1}{4}$ long, to make a foot of Tim-
ber at that circumference.

But for very large pieces, count
1 foot on the right for 12 foot, 2,
24, *&c.* and ſet 1 foot on the left,
as before; then in the anſwer, 1 foot
on the left is 1. 12*th.* of an inch,
and 1 inch 1. 14*th.* of an inch.

Example.

At 144 foot about, 1. 144*th.* part
of an inch, is a foot of Timber.

PROB. II.

For very ſmall wood, to find a foot in length.

But for very ſmall pieces of under 4 inches about, ſet 1 foot, 2 foot, *&c.* on the right (counted for 1 inch, 2 inches, 3 inches, or 4 inches) to 1 foot on the left, then right againſt TR or round, you have a number, which multiplied by 12, is the number of feet required. *Example.*

At 1 inch round true meaſure is 151 foot *ferè*, but for the uſual allowance 196, which numbers multiplied by 12, is the number of feet required, *viz.* 1809, and 2352. But note, you muſt read the 196, and 151 right, as thus; 1 foot on the left is 12, 2 is 24, *&c.* ſo that 12 foot is 144, and our number by the ſame account is 151 near.

To find how much is in a foot in length, ſet round or TR to 1 foot on the left, then right againſt the inches, or feet and inches about, found on the right, on the left is the anſwer required.

PROB.

PROB. III.

The inches, or feet and inches about and length given, to find the content.

Set the word round, or TR for the usual or true measure, to the length on the left; then right against the inches about on the right, on the left is the content required.

Example.

At 2 foot 3 inches about, and 20 foot long, it is 6 foot 2 inches of the usual allowance, or 8 foot of true measure.

But if it be a great Tree, then set TR, or round to 1 called 10, or to 10 called 100, then is the content augmented to 1000 foot, as you did in the Rules for square Timber.

But if you would have it measure bigger still, then set the 4 inches or TR set close by the brass on the right side, to the length on the left, either as it is, or augmented, counting at last according; (the note 1 foot on the right is 12 foot, and 12

at the top is 144 foot) then right against the feet about on the right, on the left is the content required.

Examp. A Brewers Tun 3 foot long or deep, and 72 foot about, set the TR by the brass to 36 inch. (which is thus counted) on the left side; (1 inch is 10 inches, 2 is 20, 3 is 30, 3¼ is 35, somewhat more is 36; so then 1 foot is 120 inches, or 10 foot) then right against 6 times 12 foot on the right (which is at 6 foot) on the left you have 12 30 foot, as near as the Rule will give it, which counting 6 foot to a barrel, is 205 barrels, the content required.

PROB. IV.

To find the content of a very small piece.

Set the word round, or TR to the length on the left, as in the third Problem of this Chapter; then right against the inches about on the right, (calling 1 foot 1 inch and 6 inches ½ an inch) on the left

is the 13*s.* of 1 inch) or 12*s.* of a 12*th.* required. *Example.*

At half an inch about, and 10 foot long, it is 2 12*s.* and a half of 1 12*th.* of an inch, or 2 ſquare inches and ½ true meaſure. Again, 2 inches ¼ about, and 10 foot long, is half an inch of true meaſure, 12 inches to a foot ſolid, or ½ a foot ſuperficial of one inch thick.

CHAP. VI.

To meaſure Timber, having the Diameter and the length given.

PROB. I.

The Diameter given in inches, to find the length of a foot.

Set 1 foot on the left to the inches diameter on the right: then right againſt TD for true diameter or the word diameter for the uſual allowance (of a ſtring girt about and doubled 4 times for the ſide of the ſquare) you have the feet and inches required. *Example.*

At 10 inches diameter, 1 foot 10 inches makes a foot.

But for very great pieces, set 1 foot as before, but look for TD beyond the upper 12, & right against it on the left you have the 12 of 1 inch, or the 12s. of a 12, that makes 2 foot.

But for very small sticks, set 1, 2, or 3 foot on the right (for 1, 2, or 3 inches) to 1 foot on the left, then right against TD or Diameter, you have a number, which multiplied by 12, is the number of feet required to make a foot of Timber.

Examp. At 1 inch Diameter you shall have 15 foot 3 inches and better, which multiplied by 12 is 123 foot 3 inches. Note, that 1 on the left is reckoned 10 foot, and 2. 20 foot, as before in the same Rule, for the circumference, and then note 1 inch is 10 inches.

At any diameter, to find how much is in 1 foot long, do thus, set Diam. or TD to 1 foot, then just against

againſt the inches, or feet and inches diameter found on the right, on the left is the anſwer. *Example.*

At 2 foot diameter is 3 foot 2 inches in 1 foot of length, which multiplied by the length, gives the true content of any round piece, and very exactly.

PROB. II.

The diameter and length given, to find the true content.

For all ordinary pieces, ſet the word diameter for the uſual meaſure, or TD for true meaſure, always to the length on the left; then right againſt the inches or feet and inches diameter on the right, on the left is the content required.

Examp. At 5 inches diameter, and 30 foot long, you ſhall find 4 foot and $\frac{1}{2}$ an inch true meaſure for the content required.

But for very ſmall pieces ſet TD or Diam. to the length, as before; then counting 1 foot on the right for 1 inch, and 6 inches for $\frac{1}{2}$ an

inch; on the left you shall have the answer or content required. But note, as the right side is diminished, so is the left, for 1 foot on the left is a 12*th*. of an inch of Timber, whereof 12 makes a foot, or 1 long inch, a foot long, and 1 inch square, and every inch on the left is 1 square inch; thus, at 2 foot long, and half an inch diameter, it is 4 □ inches, $\frac{4}{4}$ in content.

But for a great piece under 1000 foot, set TD or diameter to 1, 2, or 3 foot, called 10, 20, or 30 foot: then right against the feet and inches diameter, you have a content augmented accordingly, as at 30 foot long, and 7 foot diameter, you have 1140 foot, for the true content using TD.

Note, that in large Taper-timber, whether square or round, when it is measured by the usual way; that is, by the middle square or girt, or the 2 squares or girts put together, and the half counted for the

the equal ſquare, or girt; I ſay, a ſquare of half the difference of the ſquares or girts, and one part of the length is to be added to the former meaſure, as is proved in the circles of proportion, *pag.* 50.

As thus for Example.

Suppoſe a Taper piece be at one end 16 inches ſquare, at the other 30 inches ſquare, and 30 foot long, the ſqnare in the middle is like to be 23 inches, the content then is 110 foot; now half the difference of the two ends ſquare is 7 inches, and 1 third part of the length is 10 foot; a piece 7 inches ſquare, and 10 foot long, is 3 foot 5 inches which added, is 113 foot 5 inches, the true content of that taper piece aboveſaid.

The general way of Gauging by this Rule, is thus.

Set the W. or the A. for Wine or Ale-meaſure, always to the length of the Veſſel found out on the left. Then right againſt the mean Dia-

meter

meter found out on the right ſide, on the left is the anſwer required.

Examp. At 30 inches Diameter and 36 long, you ſhall find about 90 gallons and a half Ale-meaſure.

The Gage-point for a Beer-barrel is near 3 foot, and the Ale-barrel near 34 inches, which uſe thus.

Set 3 to the depth of the Tun, then right againſt the mean Diam. is the content in Barrels.

Example.

Set 3 to 36 inches, and then right againſt 5 foot Diam. is 10 barrels of Beer-meaſure, a very good and ſpedy way.

FINIS.